

EXHIBIT

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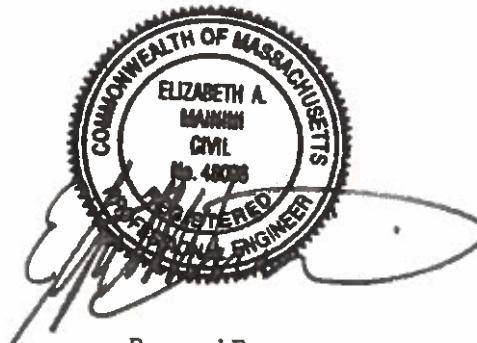
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SEP 14 2017

PLANNING BOARD
GRAFTON, MA

Stormwater Report “The Village At Institute Road” Grafton, MA

Date: September 13, 2016
Revised February 2, 2017
Revised June 26, 2017
Revised August 25, 2017



Prepared For:
*D&F Afonso Builder Corp.
189 Main Street
Milford, Ma 01757*

Prepared By:

HYDROLOGIC & HYDRAULIC REPORT

"The Village At Institute Road", Grafton Ma

Rev. 6/26/17

SITE LOCATION & DESCRIPTION

The site is located off of Institute Road in Grafton Massachusetts. Figure 1 shows the site locus.

The project locus contains approximately 62.9 acres of land. The existing property is presently undeveloped and consists of one lot. The site consists of mainly wooded area. The parcel has many cart paths that run throughout it as shown on Pre-Development Drainage Map. The existing topography slopes from southeast to northwest toward the wetland located in the northwest corner of the lot. The parcel also has a vernal pool located in the center of the project adjacent to Institute Road.

PROJECT DESCRIPTION

The project proponent proposes to construct a 46 lot residential development. This development is known as "The Village At Institute Road" and consists of 46 single family homes serviced by public water and sewer and driveway as shown conceptual on the Definitive Plans. The development also includes construction of three 26' wide paved roadways as shown on the plans. The proposed drainage system will consists of catch basins and drain manholes along the proposed roadways and directed to a forebay and infiltration basin.

DESCRIPTION OF EXISTING DRAINAGE FACILITIES

In present condition the project was divided into 5 drainage areas with four interest points as shown on the drainage map. The first interest point is an isolated wetland located at the center of the site adjacent to Institute Road. The second interest point is the property line to the west of the project. The third interest point is the wetland located in the northwest corner and the fourth interest point is the property line to the north. The drainage areas are as follows:

1. Drainage Area E1 consists of woodland and a portion of Institute Road. This Drainage Area flows from the site toward the wetland located adjacent to the Institute Road. This is a vernal pool and isolated wetland(IP#1).
 2. Drainage Area E2 consists of woodland area with gravel cart paths that run through the drainage area. This runoff flows toward the west property line.(IP#2)
 3. Drainage Area E3 consists of woodland area, existing site adjacent to the project. This drainage area flows overland toward large wetland located in the northwest corner of the lot. (#IP3)
 4. Drainage Area E4 consists of woodland area that flows overland offsite toward the north. (IP#4)
 5. Drainage Area E5 consists of woodland area that flows overland offsite toward property line. (IP#5)
6. All Drainage Areas will have roof area directed into recharge areas.

Please refer to the Pre-Development Plan.

DESCRIPTION OF PROPOSED DRAINAGE FACILITIES

In the proposed state there will be . 7 general runoff areas. They are as follows:

1. Drainage Area 1P will be collected and directed runoff into a water quality grass swale toward the existing wetland located adjacent to Institute Road, which is also a vernal pool. This area consists of a grass area along the back of the proposed house, portion of driveways and roofs from the proposed houses and woodland areas that will remain undisturbed and portion of Institution Road. (#IP1P)
2. Drainage area 2P will be direct runoff toward the west property line. This area consists of a grass area in back yards along the new street and portion of driveways and roofs from the proposed houses and portion of proposed street. (#IP2P)
3. Drainage area 3P will be collected by catch basins in proposed roadways and directed into proposed stormceptor then forebay and then into proposed infiltration basin. The area will discharge into wetlands located in the northwest corner of project. This area consists of a grass area, wooded area, driveway and portion of the new street as well as portion of existing street. (#IP3P)
4. Drainage area 4P will be direct runoff toward Westboro Road and the area consists of lawn area, wooded area, driveways and roof area.
5. Drainage area 5P will be runoff generated from wooded and grass area that flows directly into the wetlands.
6. Drainage area 6P will be runoff collected by drainage channel along portion of new street and directed into basin#2. This area consists of a grass area in the front yards along the new street and portion of driveways and roofs from the proposed houses and portion of proposed street. (#IP3P).
7. Drainage area 7P will be runoff generated from wooded and grass area that flows directly off site.

CALCULATION PROCEDURE

Procedures developed by the U. S. Department of Agriculture Soil Conservation Service (SCS) as found in Technical Release 20 (TR20) were used to determine the rates and volumes of runoff generated by the study area. Calculations were performed using the computer program "HydroCAD" by Applied Microcomputer Systems, which has incorporated these SCS procedures. Pipe capacities were determined using Manning's Equations.

Runoff Areas are shown on the attached Drainage Area Plans. Calculation was done for the Two (2), Ten (10), Twenty Five (25), Fifty (50) and One Hundred-(100) Year storms. Rainfall depths used for these storms were 3.28, 4.89, 6.22, 7.42 and 8.84 inches respectively. Calculation summaries are attached to this report.

SOIL MAPS

The SCS has also performed soil mapping of the South Worcester County. The soils mapping indicate that the site is located within Hydrologic Soil Group B, See the Pre & Post Development Plans. Deep hole tests and perc tests were done throughout the Site refer, to the Grading Plan for locations. Deep test hole results indicate that the proposed underground basins are located in loamy sand & gravelly material and have a perc rate of less than 10 minutes per inch.

POLLUTANT REMOVAL

This project will incorporate facilities that will collect stormwater pollutants. Collection of pollutants will be accomplished by:

- | | |
|---------------------------|-----|
| a. Deep sump catch basins | 25% |
|---------------------------|-----|

b.	Stormceptor	80%
c	Infiltration Basins	80%
e.	Grass Swale	50%

(Refer to attached worksheets)

SUMMARY REACH IP#1
 (Wetlands – Vernal Pool)

Storm Event	Pre-Development		Post-Development	
2 yr.	1.26	cfs	0.181	af
10 yr.	4.86	cfs	0.544	af
25 yr.	8.88	cfs	0.933	af
50 yr.	12.96	cfs	1.330	af
100 yr.	18.16	cfs	1.841	af

SUMMARY REACH IP#2
 (West Property Line)

Storm Event	Pre-Development		Post-Development	
2 yr.	2.67	cfs	0.379	af
10 yr.	11.34	cfs	1.142	af
25 yr.	20.75	cfs	1.956	af
50 yr.	30.28	cfs	2.788	af
100 yr.	42.43	cfs	3.860	af

SUMMARY REACH IP#3
 (Wetlands Northwest Corner PArcel)

Storm Event	Pre-Development		Post-Development	
2 yr.	4.33	cfs	0.730	af
10 yr.	16.16	cfs	2.133	af
25 yr.	28.80	cfs	3.613	af
50 yr.	41.53	cfs	5.118	af
100 yr.	57.70	cfs	7.051	af

SUMMARY REACH IP#4
 (North Property Line)

Storm Event	Pre-Development		Post-Development	
2 yr.	1.92	cfs	0.292	af
10 yr.	7.88	cfs	1.117	af
25 yr.	14.32	cfs	1.915	af
50 yr.	20.86	cfs	2.732	af
100 yr.	29.19	cfs	3.785	af

Basin Summary Table

BASINS PROPOSED CONDITIONS

<u>BASIN</u>	<u>UNITS</u>	<u>100 YR.</u>	<u>50 YR.</u>	<u>25 YR.</u>	<u>10 YR.</u>	<u>2 YR.</u>
1	Qin = CFS	35.54	27.54	20.93	13.90	6.22
	Qout = CFS	11.05	8.45	4.98	3.60	1.32
	ELEV. = FT	380.39	379.35	378.43	377.08	375.66
	VOL. ST. = cf	72,625	56,915	44,354	28,066	13,641
2	Qin = CFS	22.11	16.34	11.71	7.02	2.33
	Qout = CFS	12.98	9.89	6.35	4.19	0.99
	ELEV. = FT	374.66	373.74	372.90	371.77	370.61
	VOL. ST. = cf	34,912	26,136	19,187	11,359	5,202

Narrative:

The project proponent proposes to construct a 46 lot residential development. This development is known as "The Village At Institute Road" and consists of 46 single family homes serviced by public water and sewer and driveway as shown conceptual on the Definitive Plans. The development also includes construction of three 26' wide paved roadways as shown on the plans. The proposed drainage system will consist of catch basins and drain manholes along the proposed roadways and directed to a forebay and infiltration basin.

The itemized report that follows will document design compliance with the Massachusetts Stormwater Management Standards 1-10.

Date



Peter M. Lavoie

Massachusetts Stormwater Report Checklist

Stormwater Report

A Stormwater Report must be submitted with the permit application to document compliance with the Stormwater Management Standards. The Stormwater Report must be organized into sections that correspond to the categories listed in the Checklist (e.g., Project Type, LID Practices, Standard 1 etc.). As noted in the Checklist, the Stormwater Report must contain the engineering computations and supporting information set forth in Volume 3 of the Massachusetts Stormwater Handbook. The Stormwater Report must be prepared by a Registered Professional Engineer (RPE) licensed in the Commonwealth.

The Stormwater Report must include:

- Applicant/Project Name
- Project Address
- Name of Firm and Registered Professional Engineer that prepared the Report
- Long-Term Pollution Prevention Plan required by Standards 4-6
- Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan required by Standard 8¹
- Operation and Maintenance Plan required by Standard 9
- The Stormwater Checklist completed and stamped by a Registered Professional Engineer (attached) that certifies that the Stormwater Report contains all required submittals.²

In addition to all plans and supporting information, the Stormwater Report must include a brief narrative describing stormwater management practices, including environmentally sensitive site design and LID techniques, along with a diagram depicting runoff through the proposed BMP treatment train. Plans are required to show existing and proposed conditions, identify all wetland resource areas, NRCS soil types, critical areas, Land Uses with Higher Potential Pollutant Loads (LUHPPL), and any areas on the site where infiltration rate is greater than 2.4 inches per hour. The Plans shall identify the drainage areas for both existing and proposed conditions at a scale that enables verification of supporting calculations.

As noted in the Checklist, the Stormwater Management Report shall document compliance with each of the Stormwater Management Standards as provided in the Massachusetts Stormwater Handbook. The soils evaluation and calculations shall be done using the methodologies set forth in Volume 3 of the Massachusetts Stormwater Handbook.

To ensure that the Stormwater Report is complete, applicants are required to fill in the Stormwater Report Checklist by checking the box to indicate that the specified information has been included in the Stormwater Report. If any of the information specified in the checklist has

¹ For some complex projects, it may not be possible to include the Construction Period Erosion and Sedimentation Control Plan in the Stormwater Report. In that event, the issuing authority has the discretion to issue an Order of Conditions that approves the project and includes a condition requiring the proponent to submit the Construction Period Erosion and Sedimentation Control Plan before commencing any land disturbance activity on the site.

² The Stormwater Report may also include the Illicit Discharge Compliance Statement required by Standard 10. If not included in the Stormwater Report, the Illicit Discharge Compliance Statement must be submitted prior to the discharge of stormwater runoff to the post-construction best management practices.

Massachusetts Stormwater Report Checklist

not been submitted, the applicant must provide an explanation. The completed Stormwater Report Checklist and Certification must be submitted with the Stormwater Report.

Stormwater Checklist and Certification

The following checklist is intended to serve as a guide for applicants as to the elements that ordinarily need to be addressed in a complete Stormwater Report. The checklist is also intended to provide conservation commissions and other reviewing authorities with a summary of the components necessary to comprise a comprehensive Stormwater Report that addresses the ten Stormwater Standards. *Note:* Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the item is not applicable (N.A.) and provide the reasons for that determination.

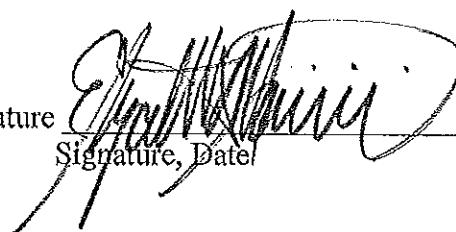
A complete checklist must include the Certification set forth below signed by the Registered Professional Engineer who prepared the Stormwater Report.

Registered Professional Engineer's Certification

I have reviewed the Stormwater Report, including the soil evaluation, computations, Long-term Pollution Prevention Plan, the Construction Period Erosion and Sedimentation Control Plan (if included), the Long-term Post-Construction Operation and Maintenance Plan, the Illicit Discharge Compliance Statement (if included) and the plans showing the stormwater management system, and have determined that they have been prepared in accordance with the requirements of the Stormwater Management Standards as further elaborated by the Massachusetts Stormwater Handbook. I have also determined that the information presented in the Stormwater Checklist is accurate and that the information presented in the Stormwater Report accurately reflects conditions at the site as of the date of this permit application.



Registered Professional Engineer Block and Signature

 2/7/17
Signature, Date

Massachusetts Stormwater Report Checklist

Project Type: Is the application for new development, redevelopment, or a mix of new and redevelopment?

- X New Development
- Redevelopment
- Mix of New Development and Redevelopment

LID Measures: Stormwater Standards require LID measures to be considered. Document what environmentally sensitive design and LID Techniques were considered during the planning and design of the project:

- X No disturbance to any Wetland Resource Areas
- Site Design Practices (e.g. clustered development, reduced frontage setbacks)
- Reduced Impervious Area (Redevelopment Only)
- Minimizing disturbance to existing trees and shrubs
- LID Site Design Credit Requested:
 - Credit 1
 - Credit 2
 - Credit 3
- X Use of “country drainage” versus curb and gutter conveyance and pipe
- Bioretention Cells (includes Rain Gardens)
- Constructed Stormwater Wetlands (includes Gravel Wetlands designs)
- Treebox Filter
- Water Quality Swale
- Grass Channel
- Green Roof
- X Other Roof recharge

Standard 1: No New Untreated Discharges

- X No new untreated discharges
- X Outlets have been designed so there is no erosion or scour to wetlands and waters of the Commonwealth
- X Supporting calculations specified in Volume 3 of the Massachusetts Stormwater Handbook included.

Standard 2: Peak Rate Attenuation

- Standard 2 waiver requested because the project is located in land subject to coastal storm flowage and stormwater discharge is to a wetland subject to coastal flooding.
- X Evaluation provided to determine whether off-site flooding increases during the 100-year 24-hour storm
- X Calculations provided to show that post-development peak discharge rates do not exceed pre-development rates for the 2-year and 10-year 24-hour storms. If evaluation shows that off-site flooding increases during the 100-year 24-hour storm, calculations are also provided to show that post-development peak discharge rates do not exceed pre-development rates for the 100-year 24-hour storm.

Standard 3: Recharge

- X Soil Analysis provided.
- X Required Recharge Volume calculation provided
- Required Recharge volume reduced through use of the LID site Design Credits.
- Sizing the infiltration, BMPs is based on the following method: Circle the method used.
 - Static
 - Simple Dynamic
 - Dynamic Field³
- X Runoff from all impervious areas at the site discharging to the infiltration BMP.
- Runoff from all impervious areas at the site is *not* discharging to the infiltration BMP and calculations are provided showing that the drainage area contributing runoff to the infiltration BMPs is sufficient to generate the required recharge volume.
- X Recharge BMPs have been sized to infiltrate the Required Recharge Volume.
- Recharge BMPs have been sized to infiltrate the Required Recharge Volume *only* to the maximum extent practicable for the following reason:
 - Site is comprised solely of C and D soils and/or bedrock at the land surface
 - M.G.L. c. 21E sites pursuant to 310 CMR 40.0000
 - Solid Waste Landfill pursuant to 310 CMR 19.000
 - Project is otherwise subject to Stormwater Management Standards only to the maximum extent practicable.
- X Calculations showing that the infiltration BMPs will drain in 72 hours are provided.
- Property includes a M.G.L. c. 21E site or a solid waste landfill and a mounding analysis is included.
- The infiltration BMP is used to attenuate peak flows during storms greater than or equal to the 10-year 24-hour storm and separation to seasonal high groundwater is less than 4 feet and a mounding analysis is provided.
- X Documentation is provided showing that infiltration BMPs do not adversely impact nearby wetland resource areas.

Standard 4: Water Quality

The Long-Term Pollution Prevention Plan typically includes the following:

- Good housekeeping practices;
- Provisions for storing materials and waste products inside or under cover;
- Vehicle washing controls;
- Requirements for routine inspections and maintenance of stormwater BMPs;
- Spill prevention and response plans;
- Provisions for maintenance of lawns, gardens, and other landscaped areas;
- Requirements for storage and use of fertilizers, herbicides, and pesticides;
- Pet waste management provisions;
- Provisions for operation and management of septic systems;
- Provisions for solid waste management;
- Snow disposal and plowing plans relative to Wetland Resource Areas;

³ 80% TSS removal is required prior to discharge to infiltration BMP if Dynamic Field method is used.

Massachusetts Stormwater Report Checklist

- Winter Road Salt and/or Sand Use and Storage restrictions;
 - Street sweeping schedules;
 - Provisions for prevention of illicit discharges to the stormwater management system;
 - Documentation that Stormwater BMPs are designed to provide for shutdown and containment in the event of a spill or discharges to or near critical areas or from LUHPPL;
 - Training for staff or personnel involved with implementing Long-Term Pollution Prevention Plan;
 - List of Emergency contacts for implementing Long-Term Pollution Prevention Plan.
- X A Long-Term Pollution Prevention Plan is attached to Stormwater Report and is included as an attachment to the Wetlands Notice of Intent.
- X Treatment BMPs subject to the 44% TSS removal pretreatment requirement and the one inch rule for calculating the water quality volume are included, and discharge:
 - is within the Zone II or Interim Wellhead Protection Area
 - is near or to other critical areas
 - is within soils with a rapid infiltration rate (greater than 2.4 inches per hour)
 - involves runoff from land uses with higher potential pollutant loads.
- The Required Water Quality Volume is reduced through use of the LID site Design Credits.
- Calculations documenting that the treatment train meets the 80% TSS removal requirement and, if applicable, the 44% TSS removal pretreatment requirement, are provided.
- X The BMP is sized (and calculations provided) based on:
 - X The $\frac{1}{2}$ " or 1" Water Quality Volume or
 - The equivalent flow rate associated with the Water Quality Volume and documentation is provided showing that the BMP treats the required water quality volume.
- The applicant proposes to use proprietary BMPs, and documentation supporting use of proprietary BMP and proposed TSS removal rate is provided. This documentation may be in the form of the proprietary BMP checklist found in Volume 2, Chapter 4 of the Massachusetts Stormwater Handbook and submitting copies of the TARP Report, STEP Report, and/or other third party studies verifying performance of the proprietary BMPs.
- A TMDL exists that indicates a need to reduce pollutants other than TSS and documentation showing that the BMPs selected are consistent with the TMDL is provided.

Standard 5: Land Uses With Higher Potential Pollutant Loads (LUHPPLs)

- X The NPDES Multi-Sector General Permit covers the land use and the Stormwater Pollution Prevention Plan (SWPPP) has been included with the Stormwater Report.
- X The NPDES Multi-Sector General Permit covers the land use and the SWPPP will be submitted *prior to* the discharge of stormwater to the post-construction stormwater BMPs.
- The NPDES Multi-Sector General Permit does *not* cover the land use.
- LUHPPLs are located at the site and industry specific source control and pollution prevention measures have been proposed to reduce or eliminate the exposure of LUHPPLs to rain, snow, snow melt and runoff, and been included in the long term Pollution Prevention Plan.
- All exposure has been eliminated

Massachusetts Stormwater Report Checklist

- All exposure has *not* been eliminated and all BMPs selected are on MassDEP LUHPPL list.
- The LUHPPL has the potential to generate runoff with moderate to higher concentrations of oil and grease (e.g. all parking lots with >1000 vehicle trips per day) and the treatment train includes an oil grit separator, a filtering bioretention area, a sand filter or equivalent.

Standard 6: Critical Areas

- The discharge is near or to a critical area and the treatment train includes only BMPs that MassDEP has approved for stormwater discharges to or near that particular class of critical area.
- Critical areas and BMPs are identified in the Stormwater Report.

Standard 7: Redevelopments and Other Projects Subject to the Standards only to the maximum extent practicable

- X The project is subject to the Stormwater Management Standards only to the maximum Extent Practicable as a:
 - Limited Project
 - Small Residential Projects:
5-9 single family houses or 5-9 units in a multi-family development provided there is no discharge that may potentially affect a critical area.
 - 2-4 single family houses or 2-4 units in a multi-family development with a discharge to a critical area
 - Marina and/or boatyard provided the hull painting, service and maintenance areas are protected from exposure to rain, snow, snow melt and runoff
 - Bike Path and/or Foot Path
 - Redevelopment Project
 - Redevelopment portion of mix of new and redevelopment.
- Certain standards are not fully met (Standard No. 1, 8, 9, and 10 must always be fully met) and an explanation of why these standards are not met is contained in the Stormwater Report.
- The project involves redevelopment and a description of all measures that have been taken to improve existing conditions is provided in the Stormwater Report. The redevelopment checklist found in Volume 2 Chapter 3 of the Massachusetts Stormwater Handbook may be used to document that the proposed stormwater management system (a) complies with Standards 2, 3 and the pretreatment and structural BMP requirements of Standards 4-6 to the maximum extent practicable and (b) improves existing conditions.

Massachusetts Stormwater Report Checklist

Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control

A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan must include the following information:

- Narrative;
- Construction Period Operation and Maintenance Plan;
- Names of Persons or Entity Responsible for Plan Compliance;
- Construction Period Pollution Prevention Measures;
- Erosion and Sedimentation Control Plan Drawings;
- Detail drawings and specifications for erosion control BMPs, including sizing calculations;
- Vegetation Planning;
- Site Development Plan;
- Construction Sequencing Plan;
- Sequencing of Erosion and Sedimentation Controls;
- Operation and Maintenance of Erosion and Sedimentation Controls;
- Inspection Schedule;
- Maintenance Schedule;
- Inspection and Maintenance Log Form.

- X A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan containing the information set forth above has been included in the Stormwater Report.
- The project is highly complex and information is included in the Stormwater Report that explains why it is not possible to submit the Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan with the application. A Construction Period Pollution Prevention and Erosion and Sedimentation Control has *not* been included in the Stormwater Report but will be submitted *before* land disturbance begins.
- The project is *not* covered by a NPDES Construction General Permit.
- The project is covered by a NPDES Construction General Permit and a copy of the SWPPP is in the Stormwater Report.
- X The project is covered by a NPDES Construction General Permit but no SWPPP been submitted. The SWPPP will be submitted BEFORE land disturbance begins.

Standard 9: Operation and Maintenance Plan

- X The Post Construction Operation and Maintenance Plan is included in the Stormwater Report and includes the following information:
 - Name of the stormwater management system owners;
 - Party responsible for operation and maintenance;
 - Schedule for implementation of routine and non-routine maintenance tasks;
 - Plan showing the location of all stormwater BMPs maintenance access areas;
 - Description and delineation of public safety features;
 - Estimated operation and maintenance budget; and
 - Operation and Maintenance Log Form.

Massachusetts Stormwater Report Checklist

- The responsible party is *not* the owner of the parcel where the BMP is located and the Stormwater Report includes the following submissions:
 - A copy of the legal instrument (deed, homeowner's association, utility trust or other legal entity) that establishes the terms of and legal responsibility for the operation and maintenance of the project site stormwater BMPs;
 - A plan and easement deed that allows site access for the legal entity to operate and maintain BMP functions.

Standard 10: Prohibition of Illicit Discharges

- X The Long-Term Pollution Prevention Plan includes measures to prevent illicit discharges;
- X An Illicit Discharge Compliance Statement is attached;
- NO Illicit Discharge Compliance Statement is attached but will be submitted *prior to* the discharge of any stormwater to post-construction BMPs.

Standard 1: No new stormwater conveyances (e.g. outfalls) may discharge untreated stormwater directly to or cause erosion in wetlands or waters of the Commonwealth.

Proposed – All road drainage is being collected and treated at the proposed basin. The new outfall discharges, treated stormwater in compliance with Standards 4 through 6.

Evaluated at a 100-year 24-hour storm event, the peak velocity of any the new outfall is non-erosive to proposed receiving surface.

Standard 2: Stormwater management systems shall be designed so that the post-development peak discharge rates do not exceed pre-development peak discharge rates. This Standard may be waived for discharges to land subject to coastal storm flowage as defined in 310 CMR 10.04.

To meet Standard 2, the post-development peak discharge rate must be equal to or less than pre-development rates to prevent storm damage and downstream flooding from the 2-year and the 10-year 24-hour storm events.

Peak discharge rates were calculated and evaluated at four locations for this project. The point of evaluation is shown on the accompanying drainage plans designated as "IP#1(vernal pool), IP#2(Property Line - West), IP#3 Wetlands Northwest corner) and IP#4(Westboro Road - North) "respectively for the pre-development conditions and post-development conditions.

In summary of the detailed calculations attached, the peak discharge rates in cubic feet per second (cfs) Please refer to the Existing & Proposed Conditions Table.

Standard 3: Loss of annual recharge to ground water shall be eliminated or minimized through the use of environmentally sensitive site design, low impact development techniques, stormwater best management practices, and good operation and maintenance. At a minimum, the annual recharge from the post- development site shall approximate the annual recharge from pre-development conditions based on soil type. This standard is met when the stormwater management system is designed to infiltrate the required recharge volume as determined in accordance with the Massachusetts Stormwater Handbook.

Hydrologic Group	Volume to Recharge x Total Impervious Area
A	0.60 inches of runoff
C	0.25 inches of runoff
B	0.35 inches of runoff
D	0.10 inches of runoff

Soils underlying the site are defined as hydrologic group "A" * (*USDA/NRCS Soil Survey of Middlesex County). From soil testing and soil texture performed in field the soil classification is B.

The required volume of recharge for post-development conditions is calculated as follows;

$$\text{Total impervious area} = 1,811,296 \text{ s.f.} (0.35 \text{ inches}/12 \text{ inches}) = 52,829 \text{ c.f.}$$

The volume of recharge provided for post-development conditions is as follows;

BMP utilized – Infiltration Basins

Recharge Basin 1	
Bottom of basin elevation	474.00
Overflow elevation	481.00
Total storage/recharge height	7.0
Total storage/recharge volume	64,442 cf (see recharge storage table)

Total Recharge Volume Provided 64,442 cf

BMP utilized – Infiltration Basins

Recharge Basin 2	
Bottom of basin elevation	470.00
Overflow elevation	475.00
Total storage/recharge height	5.0
Total storage/recharge volume	38,325 cf (see recharge storage table)

Total Recharge Volume Provided 38,325 cf

Soils

Field investigations of the soils reveal the following soil profiled for the basins:

See Soil logs.

Standard 4: Stormwater management systems shall be designed to remove 80% of the average annual post-construction load of Total Suspended Solids (TSS). This standard is met when:

- a) *Suitable practices for source control and pollution prevention are identified in a long-term pollution prevention plan, and thereafter are implemented and maintained;*
- b) *Structural stormwater best management practices are sized to capture the required water quality volume as determined in accordance with the Massachusetts Stormwater Handbook; and*
- c) *Pretreatment is provided in accordance with the Massachusetts Stormwater Handbook.*

The required Water Quality Volume, the runoff volume requiring 80% TSS removal, is calculated as follows:

Refer to the TSS worksheets. Minute

Standard 4 requires the development and implementation of suitable practices for source control and pollution prevention. These measures must be identified in a long-term pollution prevention plan.

Water Quality Volume 1P:

Total Impervious Area = 24,004 s.f. x (0.083 ft) = 1,992 cf (provided 2,000 s.f.)

The long-term pollution prevention plan is incorporated into the Operation and Maintenance Plan required by Standard 9.

Standard 5: For land uses with higher potential pollutant loads, source control and pollution prevention shall be implemented in accordance with the Massachusetts Stormwater Handbook to eliminate or reduce the discharge of stormwater runoff from such land uses to the maximum extent practicable.

The proposed project is not a use with higher potential pollutant loads.

Standard 6: Stormwater discharges within the Zone II or Interim Wellhead Protection Area of a public water supply and stormwater discharges near or to any other critical area require the use of the specific source control and pollution prevention measures and the specific structural stormwater best management practices determined by the Department to be suitable for managing discharges to such areas, as provided in the Massachusetts Stormwater Handbook.

The subject property does discharge storm water within the Zone II or Interim Wellhead Protection Area of a public water supply or to any other critical area. Pretreatment has been added to treat runoff prior to discharge into the proposed infiltration basins

Standard 7: A redevelopment project is required to meet the following Stormwater Management Standards only to the maximum extent practicable:

It is not a redevelopment project.

Standard 8: A plan to control construction-related impacts, including erosion, sedimentation, and other pollutant sources during construction and land disturbance activities (construction period erosion, sedimentation, and pollution prevention plan) shall be developed and implemented.

During land disturbance and construction activities, project proponents must implement controls that prevent erosion, control sediment movement, and stabilize exposed soils to prevent pollutants from moving offsite or entering wetlands or waters. Land disturbance activities include demolition, construction, clearing, excavation, grading, filling, and reconstruction.

Standard 8, cont'd.

Owner/Applicant: D&F Afonso Builders Corp.
189 Main Street
Milford MA 01757

B. Construction Period Pollution Prevention Measures

1. Inventory materials to be present on site during construction.
2. Train employees and subcontractors in prevention and clean up procedures.
3. All materials stored on site will be stored in their appropriate containers and if possible under a roof or covered.
4. Follow manufacturer's recommendation for disposal of used containers.
5. Store only enough product on site to do the job.
6. On site equipment, fueling and maintenance measures:
 - a. Inspect on-site vehicles and equipment daily for leaks.
 - b. Conduct all vehicle and equipment maintenance and refueling in front of building, away from storm drains.
 - c. Perform major repairs and maintenance off site.
 - d. Use drip pans, drip cloths or absorbent pads when replacing spent fuels.
 - e. Collect spent fuels and remove from site, per Local and State regulations.
 - f. Maintain a clean construction entrance where truck traffic is frequent to reduce soil compaction constant sweeping is required and limit tracking of sediment into streets, sweeping street when silt is observed on street.
7. Stock pile materials, and maintain Erosion Control around the materials where it can easily be accessed. Maintain easy access to clean up materials to include brooms, mops, rags gloves, goggles, sand, sawdust, plastic and metal trash containers.
8. Clean up spills.
 - a. Never hose down "dirty" pavement or impermeable surfaces where fluids have spilled. Use dry clean up methods (sawdust, cat litter and/or rags and absorbent pads).
 - b. Sweep up dry materials immediately. Never wash them away or bury them.
 - c. Clean up spills on dirt areas by digging up and properly disposing of contaminated soil in a certified container and notify a certified hauler for removal.
 - d. Report significant spills to the Fire Department.
9. It is the responsibility of the site superintendent or employees designated by the Applicant to inspect erosion control and repair as needed, also to inspect all on site vehicles for leaks and check all containers on site that may contain hazardous materials daily.

C. Erosion and Sedimentation Control Plan;

1. See Erosion Control Plans.

D. Site Development Plans;

1. See Grading Plans.

E. Construction Plans

1. Construction Sequencing Plan
 - a. Record Order of Conditions - The site superintendent shall be aware of all the Conditions contained within the Order including inspection schedules.
 - b. Install DEP File # Sign.
 - c. Prior to any work on the site including tree/brush clearing, the approved limit of clearing as well as the location of the proposed erosion control devices (such as silt

- fence/straw bales, etc.) must be staked on the ground under the direction of a Massachusetts registered Professional Land Surveyor.
- d. Install silt fence/mulch sock at locations
 - e. Strip off top and subsoil. Stockpile material to be reused away from the wetland, remove excess material from the site. Install and maintain erosion control barrier around stockpile.
 - f. Rough grade site, maintaining a temporary low area/sediment trap away from the wetland.
 - g. Construct drainage outfalls and stilling basin. Stabilize side slopes with loam, seed and mulch.
 - h. Install underground utilities; protect all open drainage structures with erosion/siltation control devices.
 - i. Install binder course of bituminous asphalt.
 - j. Install wearing course of asphalt, and striping (where required).
 - k. Maintain all erosion control devices until site is stabilized and a Certificate of Compliance is issued by the Conservation Commission.
 - l. The Contractor shall be responsible to schedule any required inspections of his/her work.
2. Construction Waste Management Plan
 - a. Dumpster for trash and bulk waste collection shall be provided separately for construction.
 - b. Recycle materials whenever possible (paper, plaster cardboard, metal cans). Separate containers for material are recommended.
 - c. Segregate and provide containers for disposal options for waste.
 - d. Do not bury waste and debris on site.
 - e. Certified haulers will be hired to remove the dumpster container waste as needed. Recycling products will also be removed off site weekly.
 - f. The sewer system is only for disposal of human waste, and substances permitted for disposal in the site sewer permit with the Town DPW.

F. Operation and Maintenance of Erosion and Sedimentation Controls

The operation and maintenance of sedimentation control shall be the responsibility of the contractor. The inspection and maintenance of the stormwater component shall be performed as noted below. The contractor shall have erosion control in place at all times. The contractor, based on future weather reports, shall prepare and inspect all erosion control devices; cleaning, repairing and upgrading is a priority so that the devices perform as per design. Inspect the site during rain events. Don't stay away from the site. At a minimum there should be inspection to assure the devices are not clogged or plugged, or that devices have not been destroyed or damaged during the rain event. After a storm event inspection is required to clean and repair any damage components. Immediate repair is required.

G. Inspection and Maintenance Schedules

1. Inspection must be conducted at least once every 7 days and within 24 hours of the end of a storm event 0.5 inches or greater.
2. Inspection frequency can be reduced to once a month if:
 - a. The site is temporarily stabilized.
 - b. Runoff is unlikely due to winter conditions, when site is covered with snow or ice.
3. Inspections must be conducted by qualified personnel, "qualified personnel" means a person knowledgeable in the principles and practice of erosion and sediment controls and who possess the skills to assess the conditions and take measures to maintain and ensure proper operation, also to conclude if the erosion control methods selected are effective.

4. For each inspection, the inspection report must include: (See attached inspection and maintenance log)
 - a. The inspection date.
 - b. Names, titles of personnel making the inspection.
 - c. Weather information for the period since the last inspection.
 - d. Weather information at the time of the inspection.
 - e. Locations of discharges of sediment from the site, if any.
 - f. Locations of BMP's that need to be maintained.
 - g. Locations where additional BMP's may be required.
 - h. Corrective action required or any changes to the SWPPP that may be necessary.

5. The owner, or their representative, such as the contractor, shall inspect the following in-place work;

Inspection Schedule:

Erosion Control	Weekly
Catch Basins & Drop Inlets	Weekly
Temporary Sedimentation Traps/Basins	Weekly
Street & Parking Area Sweeping	Daily

Please Note: Special inspections shall also be made after a significant rainfall event.

Maintenance Schedule

Erosion Control Devices Failure	Immediately
Catch Basins	Sump 1/4 full of sediment
Temporary Sedimentation Traps/Basins	As needed
Street Sweeping	14 days minimum and prior to any significant rain event.

Please Note: Special maintenance shall also be made after a significant rainfall event.

H. Inspection and Maintenance Log Form. (Log Form Follows)

**WEEKLY
Inspection and Maintenance Log FOR: w2658
AFTER CONSTRUCTION & After 0.5" Rain**

Components	Date
Forebay Area Basin#1&2 - twice a year	
Comments during insp.	
Note corrective measures performed & Date	
Stormceptor prior to Basin#1 -twice a year	
Comments during insp.	
Note corrective measures performed & date	
Catch Basins - twice a year	
Comments during insp.	
Note corrective measures performed & date	
Basin#1 outlet - twice a year	
Comments during insp.	
Note corrective measures performed & date	
Inverts at Headwalls - twice a year	
Comments during insp.	
Note corrective measures performed & date	
Inspector _____ Title _____ Date _____	
Address _____ Tel# _____	

**WEEKLY
Inspection and Maintenance Log FOR: w2658
AFTER CONSTRUCTION & After 0.5" Rain**

Components	Date
Notify Cons. Comm. Issues effecting Resource Areas	
Comments during insp.	
Note corrective measures performed & date	
Illicit Drainage	
Discharge --	
Comments during insp.	
Note corrective measures performed & date	
Access to basin area	
-- twice a year	
Comments during insp.	
Note corrective measures performed & date	
Any Spill Fuel, Chemical- -as-needed	
Comments during insp.	
Note corrective measures performed & date	
Infiltration Basin#1&2	
-Once a year	
Comments during insp.	
Note corrective measures performed & date	
Crush Stone Aprons at outlets	
-Twice a year and replenish stone as needed	
Comments during insp.	
Note corrective measures performed & date	
Inspector _____	Title _____
Date _____	

**WEEKLY
Inspection and Maintenance Log FOR: W2658
DURING CONSTRUCTION & After 0.5" Rain**

Components	Date
Erosion Control – Weekly Comments during insp.	
Note corrective measures performed & Date	
On Site Pavement Sweeping – as Needed Comments during insp.	
Note corrective measures performed & date	
Catch Basin with Silt Sack & Haybales – Monthly Comments during insp.	
Note corrective measures performed & date	
Temporary Basin Institute Road Area as Needed Comments during insp.	
Note corrective measures performed & date	
Temporary Basin Areas as Needed Comments during insp.	
Note corrective measures performed & date	
Inspector _____	Title _____
Address _____	Tel# _____

**WEEKLY
Inspection and Maintenance Log
DURING CONSTRUCTION**

FOR: W2658
& After 0.5" Rain

Components	Date
Notify Cons. Comm. Issues effecting Resource Areas	
Comments during insp.	
Note corrective measures performed & date	
Silt of Public Streets – Daily	
Comments during insp.	
Note corrective measures performed & date	
Stockpile Materials Ring with Haybales – Weekly	
Comments during insp.	
Note corrective measures performed & date	
Any Spill Fuel, Chemical-Daily	
Comments during insp.	
Note corrective measures performed & date	
Temporary Ground Cover Area – Weekly	
Comments during insp.	
Note corrective measures performed & date	
Temporary Stone at Access Drive as Needed	
Comments during insp.	
Note corrective measures performed & date	
Inspector _____	Title _____
_____ _____	Date _____

Standard 9: A Long -Term Operation and Maintenance (O&M) Plan shall be developed and implemented to ensure that stormwater management systems function as designed.

The following shall serve as the (O&M) Plan required by Standard 9, as well as the Long Term Pollution Prevention Plan required by Standard 4.

A. Names of Persons or Entity Responsible for Plan Compliance:

Owner/Applicant: Town of Grafton

B. Good housekeeping practices

1. Maintain site, landscaping and vegetation.
2. Sweep and pick up litter on pavements and grounds.
3. Deliveries shall be monitored by owners or representative to ensure that if any spillage occurs, it shall be contained and cleaned up immediately.
4. Maintain pavement and curbing in good repair.

C. Requirements for routine inspections and maintenance of stormwater BMPs

1. Plans: The stormwater Operation and Maintenance Plan shall consist of all Plans, documents and all local state and federal approvals as required for the subject property.
2. Record Keeping:
 - a. Maintain a log of all operation and maintenance activities for at least three years following construction, including inspections, repairs, replacement and disposal (for disposal, the log shall indicate the type of material and the disposal location);
 - b. Make this log available to MassDEP and the Conservation Commission upon request; and
 - c. Allow MassDEP and the Conservation Commission to inspect each BMP to determine whether the responsible party is implementing the Operation and Maintenance Plan.
3. Descriptions and Designs: The Best Management Practices (BMP) incorporated into the design include the following:
 - a. Street Sweeping – Stipulated within the Construction Period Pollution Prevention Plan, the Long Term Pollution Prevention Plan, and the Operation and Maintenance Plan. As the amount of TSS removal is discretionary, no credit was taken within the calculations for this BMP.
 - b. Deep sump catch basins with hoods installed to promote TSS Removal of solids and control floatable pollutants. This BMP has a design rate of 25% TSS Removal.
 - c. Forebay TSS Removal of solids and control floatable pollutants This BMP has a design rate of 25% TSS Removal.
 - d. Infiltration basin to provide the required recharge as well as provide an additional 80% TSS Removal. Refer to TSS Removal Worksheet in Standard 4 for treatment train.
4. BMP Maintenance: After construction it is the responsibility of the owner to perform maintenance. The cleaning of the components of the stormwater management system shall generally be as follows:
 - a. Roadway & Parking Areas: The owner shall keep the roadway swept with a mechanical sweeper semi-annually at a minimum.
 - b. Catch Basins: Shall be cleaned by excavating, pumping or vacuuming. The sediment shall be disposed of off-site by the Owner. Inspect quarterly, remove silt when $\frac{1}{4}$ full.
 - c. Infiltration Basins: Inspect twice per year and after every major event for the first few months. Clean sediment out of isolator row in basins 2 times per year.

- d. Settling Basins & Forebay: Mow basins at least twice per year. Clean sediment out of basins 2 times per year.
 - 5. Access Provisions: All of the components of the storm water system will be accessible by the Owner
- D. Spill prevention and response plans
- 1. Inventory materials to be present on site during construction.
 - 2. Train employees and subcontractors in prevention and clean up procedures.
 - 3. All materials stored on site will be stored in their appropriate containers under a roof.
 - 4. Follow manufacturers recommendation for disposal of used containers.
 - 5. Store only enough product on site to do the job.
 - 6. On site equipment, fueling and maintenance measures:
 - a. Inspect on-site vehicles and equipment daily for leaks.
 - b. Conduct all vehicle and equipment maintenance and refueling in one location, away from storm drains.
 - c. Perform major repairs and maintenance off site.
 - d. Use drip pans, drip cloths or absorbent pads when replacing spent fuels.
 - e. Collect spent fuels and remove from site.
 - 7. Clean up spills.
 - a. Never hose down "dirty" pavement or impermeable surfaces where fluids have spilled. Use dry clean up methods (sawdust, cat litter and/or rags and absorbent pads).
 - b. Sweep up dry materials immediately. Never wash them away or bury them.
 - c. Clean up spills on dirt areas by digging up and properly disposing of contaminated soil.
 - d. Report significant spills to the Fire Department, Conservation Commission and Board of Health.
- E. Provisions for maintenance of lawns, gardens, and other landscaped areas
Use only organic fertilizer. Dispose of clippings outside of the 100 foot buffer zone to the adjacent wetland.
- F. Requirements for storage and use of herbicides, and pesticides
The application of herbicides or pesticides will be done by professional certified contractor.
- G. Provisions for operation and management of septic system
The system shall be inspected and maintained according to the schedule noted on the approved Board of Health plan.
- H. Provisions for solid waste management
- 1. Waste Management Plan
 - a. Dumpster for trash and bulk waste collection shall be stored inside or under a roof.
 - b. Recycle materials whenever possible (paper, plaster cardboard, metal cans). Separate containers for material is recommended.
 - c. Do not bury waste and debris on site.
 - d. Certified haulers will be hired to remove the dumpster container waste as needed. Recycling products will also be removed off site weekly.
- I. Snow disposal and plowing plans relative to Wetland Resource Areas

Snow storage is adequate around the site for small storm events. The owner will have to coordinate snow removal to off site location due to the developments size and location of wetlands.

- J. Winter Road Salt and/or Sand Use and Storage restrictions
No sand, salt, or chemicals for de-icing will be stored outside.

- K. Street and parking lot sweeping schedules
Sweeping, the act of cleaning pavement can be done by mechanical sweepers, vacuum sweeper or hand sweeper. The quantity of sand is a direct correlation with the treatment of ice and snow and the types of chemicals and spreaders that are being used on site to manage snow. If a liquid de-icer such as calcium chloride is used as a pretreatment to new events the amount of sand is minimized. Sweeping for this site should be done semi-annually at a minimum. Collecting the particulate before it enters the catch basins is cheaper and more environmentally friendly than in a catch basin mixing with oils and greases in the surface water runoff in catch basins.
- L. Provisions for prevention of illicit discharges to the stormwater management system
The discharge into the stormwater system is not being violated, see attachment for illicit discharges compliance.
- M. Training the staff or personnel involved with implementing Long-Term Pollution Prevention Plan
The owner shall develop policies and procedures for containing the illicit spilling of oils, soda, beer, paper and litter. These wastes provide a degrading of the water quality. The placement of signs and trash barrels with lids around the site would contribute to a clean water quality site conditions.
- N. List of Emergency contacts for implementing Long-Term Pollution Prevention Plan:
Town of Grafton

Standard 10: All illicit discharges to the stormwater management system are prohibited.

Standard 10 prohibits illicit discharges to stormwater management systems. The stormwater management system is the system for conveying, treating, and infiltrating stormwater on site, including stormwater best management practices and any pipes intended to transport stormwater to the ground water, a surface water, or municipal separate storm sewer system. Illicit discharges to the stormwater management system are discharges that are not entirely comprised of stormwater. Notwithstanding the foregoing, an illicit discharge does not include discharges from the following activities or facilities: firefighting, water line flushing, landscape irrigation, uncontaminated ground water, potable water sources, foundation drains, air conditioning condensation, footing drains, individual resident car washing, flows from riparian habitats and wetlands, dechlorinated water from swimming pools, water used for street washing and water used to clean residential buildings without detergents.

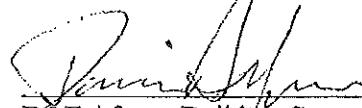
Proponents of projects within Wetlands jurisdiction must demonstrate compliance with this requirement by submitting to the issuing authority an Illicit Discharge Compliance Statement verifying that no illicit discharges exist on the site and by including in the pollution prevention plan measures to prevent illicit discharges to the stormwater management system, including wastewater discharges and discharges of stormwater contaminated by contact with process wastes, raw materials, toxic pollutants, hazardous substances, oil, or grease. The Illicit Discharge Compliance Statement may be filed with the Notice of Intent. If the Illicit Discharge Compliance Statement has not been filed, the Final Order of Conditions shall require the submission of an Illicit Discharge Compliance Statement prior to the start of construction. The issuing authority should not issue a Certificate of Compliance until it has determined that the Illicit Discharge Compliance Statement has been submitted, has reviewed the Illicit Discharge Compliance Statement, and has verified that there are no illicit discharges at the site.

(Illicit Discharge Compliance Statement Follows)

Attachment
Illicit Discharge Compliance Statement

It is the intent of the Applicant D&F Afonso Builders Corp. to control illicit disposal into the storm drainage system. There will be no connection to the storm water system to inadvertently direct other types of liquids, chemicals or solids into the storm drainage system. The Applicant will also promote a clean Green Environment by mitigating spills onto pavements; oils, soda, chemicals, pet waste, debris and litter.

Respectfully Acknowledged,



D&F Afonso Builders Corp



Guerriere & Halnon, Inc.

ENGINEERING & LAND SURVEYING

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Est. 1972

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W-2658

VILLAGE AT INSTITUTE PHASING NARRATIVE

Phase 1

- Installation of the force main from the existing sewer in Westboro Road to the proposed pump station.
- Construction of the sewer pump station
- Construction of the gravity sewer from the pump station up Westboro Road and cross country to the end of Brooke St.
- Construction of the drainage basins
- Installation of sewer, water and drainage along the entire length of Brooke Street.
- Installation of sewer, water, and drainage along the entire length of Audriana Lane
- Construct water line connection to Institute Road from Brooke Street and Audriana Lane
- Install base coarse of pavement along entire length of Audriana Lane up to its intersection with Brooke Street.
- Install base coarse of pavement along Brooke Street from station 0+0 to 16+50, the intersection with Audriana Lane.

Phase 2

- Apply for lot releases lots 1-13, 19-34, and lots 42-45.
- Reconstruct a portion of Institute Rd. per approved plan and profile. Brooke Street and Audriana lane to be utilized to detour traffic around Institute Road construction area.

Phase 3

- Construct houses on lots released by the Planning Board.
- Construct Brooke Street from station 16+50 to the cul-de-sac
- Install water, sewer, and drainage in Dylan Way.
- Install base course of pavement Brooke Street form station 16+50 to the end of the cul-de-sac.
- Install base course of pavement Dylan Way from 0+0 to the end of the cul-de-sac.
- Construct cross country walkway from Institute road to Dylan Way.

Phase 4

- Apply for lot releases for 14-17, and lots 35-41
- Construct houses on lots 14-17 and lots 35-41

Phase 5

- Install finished pavement and street monuments
- Prepare as-built plans, as-built profiles, street layout plans, and legal descriptions.
- File application for Certificate of Completion
- Request acceptance of roadways as public ways.

Supporting Calculations

INSTRUCTIONS:

1. In BMP Column, click on Blue Cell to Activate Drop Down Menu
2. Select BMP from Drop Down Menu
3. After BMP is selected, TSS Removal and other Columns are automatically completed.

Location: (SWALE) 1P

BMP ¹	C	TSS Removal Rate ¹	D	Starting TSS Load*	E	Amount Removed (C*D)	F	Remaining Load (D-E)
Deep Sump and Hooded Catch Basin		0.25		1.00		0.25		0.75
Sediment Forebay		0.25		0.75		0.19		0.56
Water Quality Swale - Wet		0.70		0.56		0.39		0.17
		0.00		0.17		0.00		0.17
		0.00		0.17		0.00		0.17

Total TSS Removal =

Project: W-2658

Prepared By: Peter M. Lavoie

Date: 22-Jun-17

Non-automated TSS Calculation Sheet:
must be used if Proprietary BMP Proposed
1. From MassDEP Stormwater Handbook Vol. 1

* Equals remaining load from previous BMP (E)

which enters the BMP

Version 1, Automated: Mar. 4, 2008

- INSTRUCTIONS:**
1. In BMP Column, click on Blue Cell to Activate Drop Down Menu
 2. Select BMP from Drop Down Menu
 3. After BMP is selected, TSS Removal and other Columns are automatically completed.

Location: [Basin#2] 6P

BMP ¹	C TSS Removal Rate ¹	D Starting TSS Load*	E Amount Removed (C*D)	F Remaining Load (D-E)
Grass Channel	0.50	1.00	0.50	0.50
Infiltration Basin	0.80	0.50	0.40	0.10
	0.00	0.10	0.00	0.10
	0.00	0.10	0.00	0.10
	0.00	0.10	0.00	0.10

Total TSS Removal =

[] 90%

Separate Form Needs to
be Completed for Each
Outlet or BMP Train

Project: W-2658
Prepared By: Peter M. Lavote
Date: 23-Aug-16

*Equals remaining load from previous BMP (E)
which enters the BMP

Non-automated TSS Calculation Sheet
must be used if Proprietary BMP Proposed
1. From MassDEP Stormwater Handbook Vol. 1

INSTRUCTIONS:

1. In BMP Column, click on Blue Cell to Activate Drop Down Menu
2. Select BMP from Drop Down Menu
3. After BMP is selected, TSS Removal and other Columns are automatically completed.

Location: [Basin#]:3P

B	C	D	E	F
BMP ¹	TSS Removal Rate ¹	Starting TSS Load*	Amount Removed (C*D)	Remaining Load (D-E)
Deep Sump and Hooded Catch Basin	0.25	1.00	0.25	0.75
STORMceptor	0.80	0.75	0.60	0.15
Infiltration Basin	0.80	0.15	0.12	0.03
	0.00	0.03	0.00	0.03
	0.00	0.03	0.00	0.03

TSS Removal**Calculation Worksheet**

Separate Form Needs to
be Completed for Each
Outlet or BMP Train

Total TSS Removal =

Project: W-2658
Prepared By: Peter M. Lavoie
Date: 23-Aug-16

*Equals remaining load from previous BMP (E)
which enters the BMP

Non-automated TSS Calculation Sheet
must be used if Proprietary BMP Proposed
1. From MassDEP Stormwater Handbook Vol. 1

STAGE-STORAGE WORKSHEET					
		GUERRIERE & HALNON, INC. ENGINEERING & LAND SURVEYING 333 WEST STREET, MILFORD, MASS 01757			
	DATE:	2/1/2017		CLIENT:	D&F
PROJECT NUMBER:		W2658	CALCULATED BY:		
BASIN NUMBER:		Recharge	CHECKED BY:		
LOCATION:		GRAFTON			
ELEVATION (FEET)	AREA (FT ²)	AVERAGE AREA (FT ²)	VERTICAL INTERVAL (FT)	VOLUME (FT ³)	VOLUME (FT ³)
474.0	7184				0
476.0	9666	8425	2	16850	16850
478	12357	11012	2	22023	38873
480	15306	13832	2	27663	66536
481.0	16900	16103	1	16103	82639

STAGE-STORAGE WORKSHEET					
		GUERRIERE & HALNON, INC. ENGINEERING & LAND SURVEYING 333 WEST STREET, MILFORD, MASS 01767			
	DATE:	2/1/2017		CLIENT:	D&F
PROJECT NUMBER:	W2658		CALCULATED BY:		
BASIN NUMBER:	Recharge2		CHECKED BY:		
LOCATION:	GRAFTON				
ELEVATION	AREA	AVERAGE AREA	VERTICAL INTERVAL	VOLUME INCREMENTAL	VOLUME CUMULATIVE
(FEET)	(FT ²)	(FT ²)	(FT)	(FT ³)	(FT ³)
369.0	1600				0
370.0	3750	2675	1	2675	2675
372	6400	5075	2	10150	12825
374	9300	7850	2	15700	28526
375.0	10300	9800	1	9800	38325

STAGE-STORAGE WORKSHEET					
		GUERRIERE & HALNON, INC. ENGINEERING & LAND SURVEYING 333 WEST STREET, MILFORD, MASS 01757			
	DATE:	6/22/2017		CLIENT:	D&F
PROJECT NUMBER:	W2658		CALCULATED BY:		
BASIN NUMBER:	ALE/FOREBAY		CHECKED BY:		
LOCATION:	GRAFTON				
ELEVATION (FEET)	AREA (FT ²)	AVERAGE AREA (FT ²)	VERTICAL INTERVAL (FT)	VOLUME INCREMENTAL (FT ³)	VOLUME CUMULATIVE (FT ³)
439.0	130				0
442.5	1105	618	4	2161	2161

STAGE-STORAGE WORKSHEET					
		GUERRIERE & HALNON, INC. ENGINEERING & LAND SURVEYING 333 WEST STREET, MILFORD, MASS 01757			
	DATE:	2/1/2017		CLIENT:	D&F
PROJECT NUMBER:	W2658		CALCULATED BY:		
BASIN NUMBER:	Forebay		CHECKED BY:		
LOCATION:	GRAFTON				
ELEVATION	AREA	AVERAGE AREA	VERTICAL INTERVAL	VOLUME INCREMENTAL	VOLUME CUMULATIVE
(FEET)	(FT ²)	(FT ²)	(FT)	(FT ³)	(FT ³)
483.0	1320				0
484.0	2502	1911	1	1911	1911
486	2426	3951	2	7902	9813

STAGE-STORAGE WORKSHEET					
		GUERRIERE & HALNON, INC. ENGINEERING & LAND SURVEYING 333 WEST STREET, MILFORD, MASS 01767			
	DATE:	2/1/2017		CLIENT:	D&F
PROJECT NUMBER:	W2658		CALCULATED BY:		
BASIN NUMBER:	Forebay2		CHECKED BY:		
LOCATION:	GRAFTON				
ELEVATION (FEET)	AREA (FT ²)	AVERAGE AREA (FT ²)	VERTICAL INTERVAL (FT)	VOLUME (FT ³)	VOLUME (FT ³)
370.0	550				0
372.0	1617	1084	2	2167	2167
373	2769	3951	1	3951	6118

Hydrograph for Pond 5PND: BASIN#1

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Outflow (cfs)	Discarded (cfs)	Primary (cfs)
0.00	0.00	0	374.00	0.00	0.00	0.00
2.50	0.00	0	374.00	0.00	0.00	0.00
5.00	0.00	0	374.00	0.00	0.00	0.00
7.50	0.08	57	374.01	0.02	0.02	0.00
10.00	1.11	3,116	374.42	0.18	0.18	0.00
12.50	28.73	61,177	379.64	9.29	0.35	8.94
15.00	2.86	44,771	378.46	5.05	0.31	4.75
17.50	1.42	25,377	376.83	3.32	0.25	3.07
20.00	0.95	14,127	375.71	1.46	0.22	1.24
22.50	0.75	12,047	375.49	0.86	0.21	0.65
25.00	0.00	10,227	375.28	0.42	0.21	0.21
27.50	0.00	7,837	375.00	0.20	0.20	0.00
30.00	0.00	6,074	374.79	0.19	0.19	0.00
32.50	0.00	4,366	374.58	0.19	0.19	0.00
35.00	0.00	2,715	374.37	0.18	0.18	0.00
37.50	0.00	1,120	374.15	0.17	0.17	0.00
40.00	0.00	80	374.01	0.03	0.03	0.00
42.50	0.00	4	374.00	0.00	0.00	0.00
45.00	0.00	0	374.00	0.00	0.00	0.00
47.50	0.00	0	374.00	0.00	0.00	0.00
50.00	0.00	0	374.00	0.00	0.00	0.00
52.50	0.00	0	374.00	0.00	0.00	0.00
55.00	0.00	0	374.00	0.00	0.00	0.00
57.50	0.00	0	374.00	0.00	0.00	0.00
60.00	0.00	0	374.00	0.00	0.00	0.00
62.50	0.00	0	374.00	0.00	0.00	0.00
65.00	0.00	0	374.00	0.00	0.00	0.00
67.50	0.00	0	374.00	0.00	0.00	0.00
70.00	0.00	0	374.00	0.00	0.00	0.00

Hydrograph for Pond 7P: BASIN#2

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Outflow (cfs)	Discarded (cfs)	Primary (cfs)
0.00	0.00	0	369.00	0.00	0.00	0.00
2.50	0.00	0	369.00	0.00	0.00	0.00
5.00	0.00	0	369.00	0.00	0.00	0.00
7.50	0.00	0	369.00	0.00	0.00	0.00
10.00	0.33	425	369.23	0.05	0.05	0.00
12.50	21.76	22,715	373.34	7.90	0.20	7.71
15.00	2.65	12,013	371.87	4.44	0.15	4.29
17.50	1.32	6,673	370.92	1.51	0.12	1.39
20.00	0.86	5,133	370.59	0.97	0.11	0.86
22.50	0.68	4,592	370.47	0.72	0.10	0.62
25.00	0.05	3,719	370.27	0.33	0.10	0.23
27.50	0.00	2,520	369.96	0.09	0.09	0.00
30.00	0.00	1,790	369.75	0.08	0.08	0.00
32.50	0.00	1,158	369.53	0.06	0.06	0.00
35.00	0.00	624	369.32	0.05	0.05	0.00
37.50	0.00	186	369.11	0.04	0.04	0.00
40.00	0.00	6	369.00	0.00	0.00	0.00
42.50	0.00	0	369.00	0.00	0.00	0.00
45.00	0.00	0	369.00	0.00	0.00	0.00
47.50	0.00	0	369.00	0.00	0.00	0.00
50.00	0.00	0	369.00	0.00	0.00	0.00
52.50	0.00	0	369.00	0.00	0.00	0.00
55.00	0.00	0	369.00	0.00	0.00	0.00
57.50	0.00	0	369.00	0.00	0.00	0.00
60.00	0.00	0	369.00	0.00	0.00	0.00
62.50	0.00	0	369.00	0.00	0.00	0.00
65.00	0.00	0	369.00	0.00	0.00	0.00
67.50	0.00	0	369.00	0.00	0.00	0.00
70.00	0.00	0	369.00	0.00	0.00	0.00

Hydrograph for Pond PND2: BASIN#2

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Outflow (cfs)	Discreted (cfs)	Primary (cfs)
0.00	0.00	0	370.00	0.00	0.00	0.00
2.50	0.00	0	370.00	0.00	0.00	0.00
5.00	0.00	0	370.00	0.00	0.00	0.00
7.50	0.00	0	370.00	0.00	0.00	0.00
10.00	0.33	335	370.09	0.12	0.09	0.03
12.50	21.75	20,222	373.36	8.01	0.20	7.84
15.00	2.65	9,345	371.87	4.44	0.15	4.29
17.50	1.32	3,989	370.92	1.51	0.12	1.40
20.00	0.85	2,455	370.59	0.97	0.11	0.88
22.50	0.68	1,917	370.47	0.72	0.10	0.62
25.00	0.65	1,044	370.27	0.33	0.10	0.23
27.50	0.00	26	370.01	0.01	0.01	0.00
30.00	0.00	0	370.00	0.00	0.00	0.00
32.50	0.00	0	370.00	0.00	0.00	0.00
35.00	0.00	0	370.00	0.00	0.00	0.00
37.50	0.00	0	370.00	0.00	0.00	0.00
40.00	0.00	0	370.00	0.00	0.00	0.00
42.50	0.00	0	370.00	0.00	0.00	0.00
45.00	0.00	0	370.00	0.00	0.00	0.00
47.50	0.00	0	370.00	0.00	0.00	0.00
50.00	0.00	0	370.00	0.00	0.00	0.00
52.50	0.00	0	370.00	0.00	0.00	0.00
55.00	0.00	0	370.00	0.00	0.00	0.00
57.50	0.00	0	370.00	0.00	0.00	0.00
60.00	0.00	0	370.00	0.00	0.00	0.00
62.50	0.00	0	370.00	0.00	0.00	0.00
65.00	0.00	0	370.00	0.00	0.00	0.00
67.50	0.00	0	370.00	0.00	0.00	0.00
70.00	0.00	0	370.00	0.00	0.00	0.00

post development 1-17
Prepared by {enter your company name here}
HydroCAD® 10.00-16 sn 01433 © 2015 HydroCAD Software Solutions LLC

Type III 24-hr 100YR-REV Rainfall=8.84"
Printed 4/13/2017

Hydrograph for Pond PND1: BASIN#1

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Outflow (cfs)	Discarded (cfs)	Primary (cfs)
0.00	0.00	0	374.00	0.00	0.00	0.00
2.50	0.00	0	374.00	0.00	0.00	0.00
5.00	0.08	57	374.01	0.02	0.02	0.00
7.50	1.11	3,116	374.42	0.18	0.18	0.00
10.00	28.73	61,177	379.64	9.29	9.29	0.35
12.50	2.85	44,771	378.46	5.05	5.05	0.31
15.00	1.42	25,377	376.83	3.32	0.25	3.07
20.00	0.95	14,127	375.71	1.46	0.22	1.24
22.50	0.75	12,047	375.49	0.88	0.21	0.65
25.00	0.00	10,227	375.28	0.42	0.21	0.21
27.50	0.00	7,837	375.00	0.20	0.20	0.00
30.00	0.00	6,074	374.79	0.19	0.19	0.00
32.50	0.00	4,386	374.58	0.19	0.19	0.00
35.00	0.00	2,715	374.37	0.18	0.18	0.00
37.50	0.00	1,120	374.15	0.17	0.17	0.00
40.00	0.00	80	374.01	0.03	0.03	0.00
42.50	0.00	4	374.00	0.00	0.00	0.00
45.00	0.00	0	374.00	0.00	0.00	0.00
47.50	0.00	0	374.00	0.00	0.00	0.00
50.00	0.00	0	374.00	0.00	0.00	0.00
52.50	0.00	0	374.00	0.00	0.00	0.00
55.00	0.00	0	374.00	0.00	0.00	0.00
57.50	0.00	0	374.00	0.00	0.00	0.00
60.00	0.00	0	374.00	0.00	0.00	0.00
62.50	0.00	0	374.00	0.00	0.00	0.00
65.00	0.00	0	374.00	0.00	0.00	0.00
67.50	0.00	0	374.00	0.00	0.00	0.00
70.00	0.00	0	374.00	0.00	0.00	0.00

tmp#1.txt

channel calculator

Given Input Data:

Shape	Trapezoidal
Solving for	Flowrate
Slope	0.0150 ft/ft
Manning's n	0.0200
Depth	3.0000 ft
Height	3.5000 ft
Bottom width	3.0000 ft
Left slope	3.0000 ft/ft (V/H)
Right slope	3.0000 ft/ft (V/H)

Computed Results:

Flowrate	129.1966 cfs
Velocity	10.7664 fps
Full Flowrate	166.4825 cfs
Flow area	12.0000 ft ²
Flow perimeter	9.3246 ft
Hydraulic radius	1.2869 ft
Top width	5.0000 ft
Area	14.5833 ft ²
Perimeter	10.3786 ft
Percent full	85.7143 %

critical information

Critical depth	3.3843 ft
Critical slope	0.0101 ft/ft
Critical velocity	9.2476 fps
Critical area	13.9709 ft ²
Critical perimeter	10.1348 ft
Critical hydraulic radius	1.3785 ft
Critical top width	5.2562 ft
Specific energy	4.8014 ft
Minimum energy	5.0765 ft
Froude number	1.2252
Flow condition	supercritical

Brief Stormceptor Sizing Report - Institutue Village

Project Information & Location			
Project Name	w2658	Project Number	1
City	Grafton	State/Province	Massachusetts
Country	United States of America	Date	4/13/2017
Designer Information		EOR Information (optional)	
Name	Peter Lavoie	Name	
Company	Guerriere and Halnon	Company	
Phone #	508-473-6630	Phone #	
Email	plavoie@gandhengineering.com	Email	

Stormwater Treatment Recommendation

The recommended Stormceptor Model(s) which achieve or exceed the user defined water quality objective for each site within the project are listed in the below Sizing Summary table.

Site Name	Institue Village
Target TSS Removal (%)	80
TSS Removal (%) Provided	81
Recommended Stormceptor Model	STC 7200

The recommended Stormceptor Model achieves the water quality objectives based on the selected inputs, historical rainfall records and selected particle size distribution.

Stormceptor Sizing Summary	
Stormceptor Model	% TSS Removal Provided
STC 450i	61
STC 900	69
STC 1200	69
STC 1800	69
STC 2400	74
STC 3600	74
STC 4800	78
STC 6000	78
STC 7200	81
STC 11000	84
STC 13000	84
STC 16000	86
StormceptorMAX	Custom

← using for project.

Sizing Details			
Drainage Area		Water Quality Objective	
Total Area (acres)	8.79	TSS Removal (%)	80.0
Imperviousness %	34.4	Runoff Volume Capture (%)	
Rainfall			Oil Spill Capture Volume (Gal)
Station Name	WORCESTER WSO AP	Peak Conveyed Flow Rate (CFS)	35.54
State/Province	Massachusetts	Water Quality Flow Rate (CFS)	
Station ID #	9923	Up Stream Storage	
Years of Records	58	Storage (ac-ft)	Discharge (cfs)
Latitude	42°16'2"N	4.074	35.540
Longitude	71°52'34"W	Up Stream Flow Diversion	
		Max. Flow to Stormceptor (cfs)	

Particle Size Distribution (PSD) The selected PSD defines TSS removal		
Fine Distribution		
Particle Diameter (microns)	Distribution %	Specific Gravity
20.0	20.0	1.30
60.0	20.0	1.80
150.0	20.0	2.20
400.0	20.0	2.65
2000.0	20.0	2.65

Notes

- Stormceptor performance estimates are based on simulations using PCSWMM for Stormceptor, which uses the EPA Rainfall and Runoff modules.
- Design estimates listed are only representative of specific project requirements based on total suspended solids (TSS) removal defined by the selected PSD, and based on stable site conditions only, after construction is completed.
- For submerged applications or sites specific to spill control, please contact your local Stormceptor representative for further design assistance.

For Stormceptor Specifications and Drawings Please Visit:
<http://www.imbriumsystems.com/technical-specifications>

Brief Stormceptor Sizing Report - Village at Institute Road

Project Information & Location			
Project Name	w2658	Project Number	1
City	Grafton	State/ Province	Massachusetts
Country	United States of America	Date	4/13/2017
Designer Information		FOR Information (optional)	
Name	Peter Lavoie	Name	
Company	Guerriere and Halnon	Company	
Phone #	508-473-6630	Phone #	
Email	plavole@gandhengineering.com	Email	

Stormwater Treatment Recommendation

The recommended Stormceptor Model(s) which achieve or exceed the user defined water quality objective for each site within the project are listed in the below Sizing Summary table.

Site Name	Village at Institute Road
Target TSS Removal (%)	80
TSS Removal (%) Provided	83
Recommended Stormceptor Model	STC 900

The recommended Stormceptor Model achieves the water quality objectives based on the selected inputs, historical rainfall records and selected particle size distribution.

Stormceptor Sizing Summary	
Stormceptor Model	% TSS Removal Provided
STC 450i	75
STC 900	83
STC 1200	83
STC 1800	83
STC 2400	87
STC 3600	87
STC 4800	90
STC 6000	90
STC 7200	92
STC 11000	94
STC 13000	94
STC 16000	95
StormceptorMAX	Custom

Sizing Details			
Drainage Area		Water Quality Objective	
Total Area (acres)	8.58	TSS Removal (%)	
Imperviousness %	13.1	Runoff Volume Capture (%)	
Rainfall			
Station Name	WORCESTER WSO AP	Oil Spill Capture Volume (Gal)	
State/Province	Massachusetts	Peak Conveyed Flow Rate (CFS)	
Station ID #	9923	Water Quality Flow Rate (CFS)	
Years of Records	58	Up Stream Storage	
Latitude	42°16'2"N	Storage (ac-ft)	Discharge (cfs)
Longitude	71°52'34"W	3.191	22.110
Up Stream Flow Diversion			
		Max. Flow to Stormceptor (cfs)	

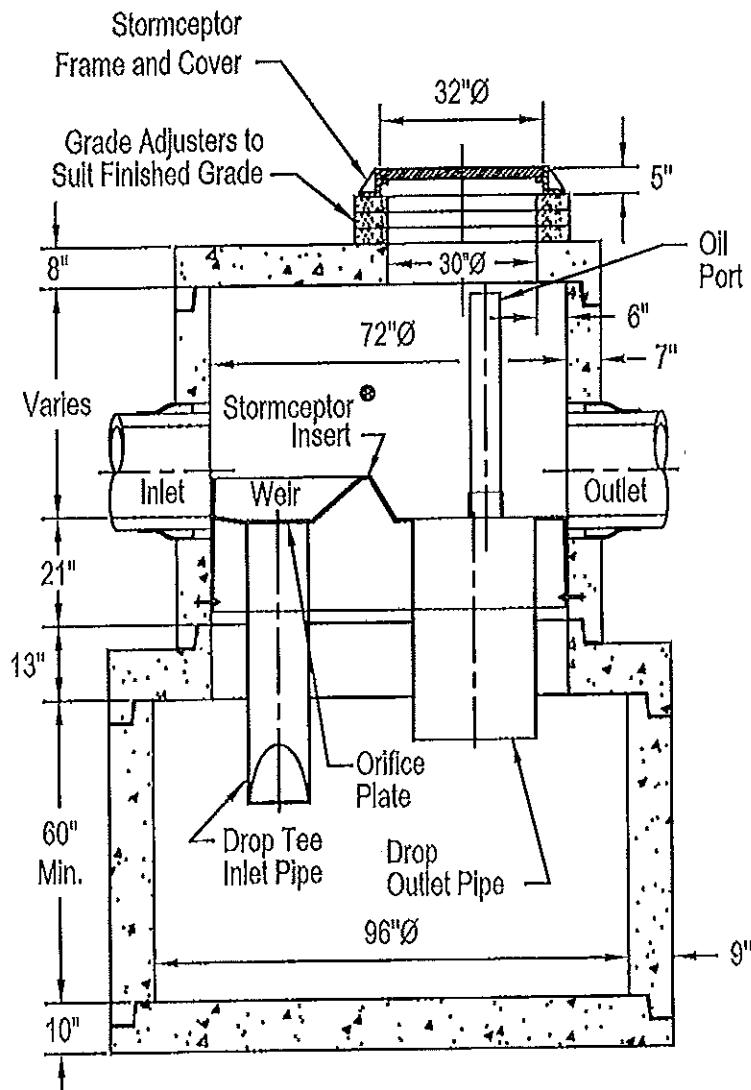
Particle Size Distribution (PSD) The selected PSD defines TSS removal		
Fine Distribution		
Particle Diameter (microns)	Distribution %	Specific Gravity
20.0	20.0	1.30
60.0	20.0	1.80
150.0	20.0	2.20
400.0	20.0	2.65
2000.0	20.0	2.65

Notes

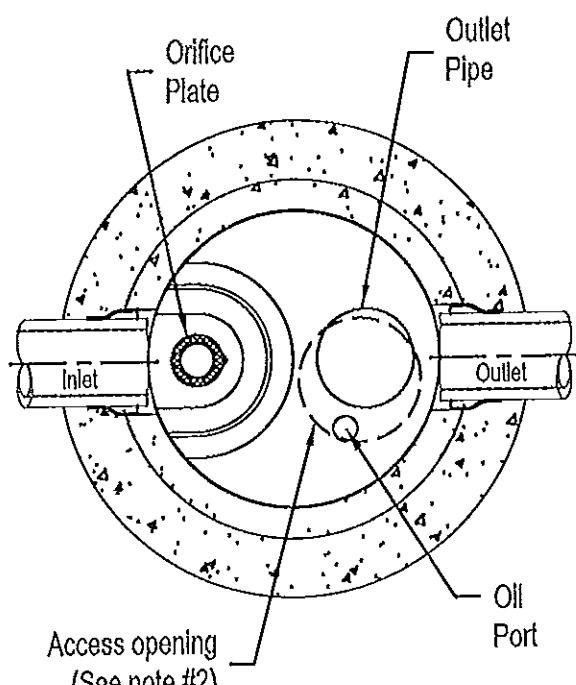
- Stormceptor performance estimates are based on simulations using PCSWMM for Stormceptor, which uses the EPA Rainfall and Runoff modules.
- Design estimates listed are only representative of specific project requirements based on total suspended solids (TSS) removal defined by the selected PSD, and based on stable site conditions only, after construction is completed.
- For submerged applications or sites specific to spill control, please contact your local Stormceptor representative for further design assistance.

For Stormceptor Specifications and Drawings Please Visit:
<http://www.imbriumsystems.com/technical-specifications>

STC 2400 Precast Concrete Stormceptor® (2400 U.S. Gallon Capacity)



Section Thru Chamber



Plan View

Notes:

1. The Use Of Flexible Connection is Recommended at The Inlet and Outlet Where Applicable.
2. The Cover Should be Positioned Over The Outlet Drop Pipe and The Oil Port.
3. The Stormceptor System is protected by one or more of the following U.S. Patents:
#5753115, #5849181, #6068765, #6371690, #7582216, #7666303.
4. Contact a Concrete Pipe Division representative for further details not listed on this drawing.



UNIVERSITY OF MASSACHUSETTS
AT AMHERST
Water Resources Research Center
Blalock House, UMass
310 Hicks Way
Amherst, MA 01003

Massachusetts Stormwater
Evaluation Project

(413) 545-5532
(413) 545-2304 FAX
www.mastep.net

MASTEP Technology Review

Technology Name: Stormceptor

Studies Reviewed: Final NJCAT Technology Verification Stormceptor STC900 September 2004; Coventry University Study, 1996; Technology Assessment, University of Massachusetts, 1997; SeaTac Stormceptor Performance report 2001; SWAMP report Ontario 2004; Phoenix Group Edmonton report 1995; Stormceptor 1200 Field Evaluation report 2004; Applied Hydrology Associates Denver report 2003; Rinker Materials Como Park St. Paul MN report 2002; VA DOT / UVA "Testing of Ultra-Urban Stormwater Best Management Practices" report 2001. Hydrodynamic Separator Sediment Retention Testing, Mohseni, 2010.

Date: September 17, 2013

Reviewer: Jerry Schoen

Rating: 2

Brief rationale for rating: This rating is primarily based on the 2005 NJCAT Technology Verification study. In general, this was a well-conducted test, which in large part followed NJDEP test guidelines for laboratory studies, which MASTEP considers as the laboratory equivalent of TARP field protocols. Issues of concern: the study measured suspended sediment concentration (SSC) rather than total suspended solids (TSS). Although SSC is considered by many scientists to be the preferred method, it is at odds with Massachusetts stormwater regulations, which are based on TSS treatment. Comparing SSC and TSS results is considered an inexact science. The test was conducted with higher influent sediment concentrations than is preferred, but results were fairly consistent across all ranges studied. The particle size distribution also appears to be slightly higher than the target test range. There are additional field studies that in general support the results obtained in this laboratory studies. These studies do not satisfy TARP protocols, but they do not contradict results obtained in the NJCAT study.

TARP Requirements Not Met*:

- Measurements in TSS.
- Influent sediment concentration is 100 – 300 mg/l: actual was 153-460.
- No documentation of a Quality Assurance Project Plan
- Third party studies are preferred. This was conducted by Stormceptor personnel, with sample analyses conducted by an external laboratory.

Other Comments:

* The 2010 Mohseni study evaluates the susceptibility of the Stormceptor to scouring, or washout of collected sediments. Report concluded that the unit does not scour at high flows as long as sediment depth does not exceed maintenance level.

* Criteria also based on NJDEP laboratory testing guidelines.

Brief Stormceptor Sizing Report - Village at Institute Road

Project Information & Location			
Project Name	w2658	Project Number	1
City	Grafton	State/Province	Massachusetts
Country	United States of America	Date	4/13/2017
Designer Information		EOF Information (optional)	
Name	Peter Lavole	Name	
Company	Guerriere and Halnon	Company	
Phone #	508-473-6630	Phone #	
Email	plavole@gandhengineering.com	Email	

Stormwater Treatment Recommendation

The recommended Stormceptor Model(s) which achieve or exceed the user defined water quality objective for each site within the project are listed in the below Sizing Summary table.

Site Name	Village at Institute Road
Target TSS Removal (%)	77
TSS Removal (%) Provided	77
Recommended Stormceptor Model	STC 2400

The recommended Stormceptor Model achieves the water quality objectives based on the selected inputs, historical rainfall records and selected particle size distribution.

Stormceptor Sizing Summary	
Stormceptor Model	% TSS Removal Provided
STC 450	64
STC 900	73
STC 1200	72
STC 1800	72
STC 2400	77
STC 3600	78
STC 4800	82
STC 6000	82
STC 7200	85
STC 11000	88
STC 13000	89
STC 16000	90
StormceptorMAX	Custom

Sizing Details			
Drainage Area		Water Quality Objective	
Total Area(acres)	8.79	TSS Removal (%)	77.0
Imperviousness %	34.4	Runoff Volume Capture (%)	
Rainfall			Oil Spill Capture Volume (Gal)
Station Name	WORCESTER WSO AP	Peak Conveyed Flow Rate (CFS)	35.54
State/Province	Massachusetts	Water Quality Flow Rate (CFS)	
Station ID #	9923	Up Stream Storage	
Years of Records	58	Storage (ac-ft)	Discharge (cfs)
Latitude	42°16'2"N	4.074	35.540
Longitude	71°52'34"W	Up Stream Flow Diversion	
		Max Flow to Stormceptor (cfs)	

Particle Size Distribution (PSD)		
The selected PSD defines TSS removal		
Fine Distribution		
Particle Diameter (microns)	Distribution %	Specific Gravity
20.0	20.0	1.30
60.0	20.0	1.80
150.0	20.0	2.20
400.0	20.0	2.65
2000.0	20.0	2.65

Notes

- Stormceptor performance estimates are based on simulations using PCSWMM for Stormceptor, which uses the EPA Rainfall and Runoff modules.
- Design estimates listed are only representative of specific project requirements based on total suspended solids (TSS) removal defined by the selected PSD, and based on stable site conditions only, after construction is completed.
- For submerged applications or sites specific to spill control, please contact your local Stormceptor representative for further design assistance.

For Stormceptor Specifications and Drawings Please Visit:
<http://www.lmbrilumsystems.com/technical-specifications>

3.3. Double Wall Containment

The Stormceptor System was conceived as a pollution identifier to assist with identifying illicit discharges. The fiberglass insert has a continuous skirt that lines the concrete barrel wall for a depth of 18 inches (457 mm) that provides double wall containment for hydrocarbons storage. This protective barrier ensures that toxic floatables do not migrate through the concrete wall into the surrounding soils.

4. Stormceptor Product Line

4.1. Stormceptor Models

A summary of Stormceptor models and capacities are listed in Table 1.

Table 1. Stormceptor Models

Stormceptor Model	Total Storage Volume U.S. Gal (L)	Hydrocarbon Storage Capacity U.S. Gal (L)	Maximum Sediment Capacity ft ³ (L)
STC 450I	470 (1,780)	86 (330)	46 (1,302)
STC 900	952 (3,600)	251 (950)	89 (2,520)
STC 1200	1,234 (4,670)	251 (950)	127 (3,596)
STC 1800	1,833 (6,940)	251 (950)	207 (5,861)
STC 2400	2,462 (9,320)	840 (3,180)	205 (5,805)
STC 3600	3,715 (1,406)	840 (3,180)	373 (10,562)
STC 4800	5,059 (1,950)	909 (3,440)	543 (15,376)
STC 6000	6,136 (23,230)	909 (3,440)	687 (19,453)
STC 7200	7,420 (28,090)	1,059 (4,010)	839 (23,757)
STC 11000	11,194 (42,370)	2,797 (10,590)	1,086 (30,752)
STC 13000	13,348 (50,530)	2,797 (10,590)	1,374 (38,907)
STC 16000	15,918 (60,260)	3,055 (11,560)	1,677 (47,487)

NOTE: Storage volumes may vary slightly from region to region. For detailed information, contact your local Stormceptor representative.

4.2. Inline Stormceptor

The Inline Stormceptor, Figure 1, is the standard design for most stormwater treatment applications. The patented Stormceptor design allows the Inline unit to maintain continuous positive treatment of total suspended solids (TSS) year-round, regardless of flow rate. The Inline Stormceptor is composed of a precast concrete tank with a fiberglass insert situated at the invert of the storm sewer pipe, creating an upper chamber above the insert and a lower chamber below the insert.

Table 4. Sediment Depths Indicating required servicing.

Sediment Depths Indicating Required Servicing *	
Model	Sediment Depth inches (mm)
450i	8 (200)
900	8 (200)
1200	10 (250)
1800	15 (381)
2400	12 (300)
3600	17 (430)
4800	15 (380)
6000	18 (460)
7200	15 (381)
11000	17 (380)
13000	20 (500)
16000	17 (380)

* based on 15% of the Stormceptor unit's total storage

Although annual servicing is recommended, the frequency of maintenance may need to be increased or reduced based on local conditions (i.e. if the unit is filling up with sediment more quickly than projected, maintenance may be required semi-annually; conversely once the site has stabilized maintenance may only be required every two or three years).

Oil is removed through the oil inspection/cleanout port and sediment is removed through the riser pipe. Alternatively oil could be removed from the 24 inches (600 mm) opening if water is removed from the lower chamber to lower the oil level below the drop pipes.

The following procedures should be taken when cleaning out Stormceptor:

1. Check for oil through the oil cleanout port
2. Remove any oil separately using a small portable pump
3. Decant the water from the unit to the sanitary sewer, if permitted by the local regulating authority, or into a separate containment tank
4. Remove the sludge from the bottom of the unit using the vacuum truck
5. Re-fill Stormceptor with water where required by the local jurisdiction

12.3. Submerged Stormceptor

Careful attention should be paid to maintenance of the Submerged Stormceptor System. In cases where the storm drain system is submerged, there is a requirement to plug both the inlet and outlet pipes to economically clean out the unit.

Institute Village, MA
Feb. 1, 2017 Rev. 6-22-17

G&H Project W-2658

Riprap Stone Sizing – Drainage Swale Outfalls

Method – ARS Rock Chutes (Slopes 2%-40%)

Reference: National Engineering Handbook, TS14C-8

#1 - Rock Apron-Basin 1 outlet (HydroCAD)

Slope = 0.028 ft/ft

q (100-yr) = 10.67 cfs

$$D_{50} = 12(1.923qS^{1.5})^{0.529}$$

D₅₀ = 4" required

D₅₀ = 6" provided

#2 - Rock Apron-Basin 2 outlet (HydroCAD)

Slope = 0.011 ft/ft

q (100-yr) = 12.74 cfs

$$D_{50} = 12(1.923qS^{1.5})^{0.529}$$

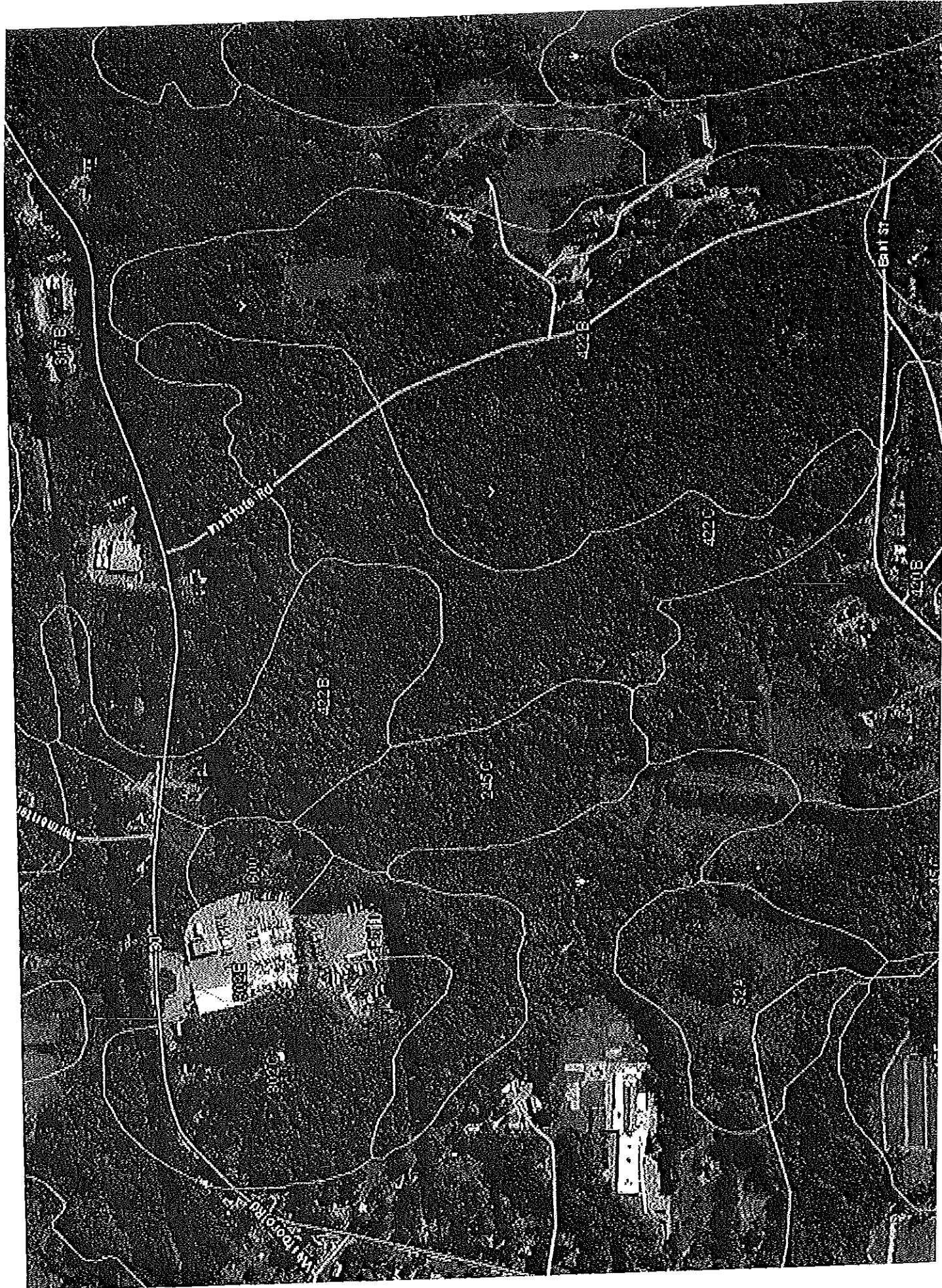
D₅₀ = 2" required

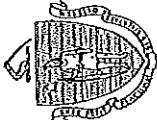
D₅₀ = 6" provided

Soil Information



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Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

Deep Observation Hole Number:

1

Depth (in.)	Soil Horizon/ Layer	Soil Matrix Color- Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume	Cobbles & Stones	Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent						
0-7	A					S.I.					
7-24	B					S.L.					
24-84	C					46"					

Additional Notes:



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C. On-Site Review (continued)

Deep Observation Hole Number:

DTH#2, Sta. 1+25

Additional Notes:



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C. On-Site Review (continued)

Deep Observation Hole Number:

91#3, 2+90

Soil Matrix Color Moist (Munsell)		Redoximorphic Features (mottles)		Soil Texture (USDA)		Coarse Fragments % by Volume		Soil Structure		Soil Consistency (Moist)		Other	
Depth (in.)	Soil Horizon/ Layer	Depth	Color	Percent		Gravel	Cobbles & Stones						
0-6	A							S.L.					
6-24	B							S.L.					
24-96	C					60"		S.L.					

Additional Notes:

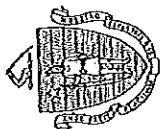


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C. On-Site Review (continued)

Deep Observation Hole Number: DTH#4, LOT44 - 40'
ROAD B

Additional Notes:

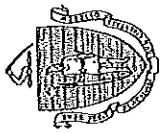


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C. On-Site Review (continued)

005, ROAD B 3400

Additional Notes:



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C. On-Site Review (continued)

Deep Observation Hole Number:

DTH#6 RD B & RD C

Depth (in.)	Soil Horizon/ Layer	Soil Matrix Color Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume	Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent					
0-6	A					S.L.				
6-28	B					S.L.				
28-82	C		64"			S.L.				

Additional Notes:



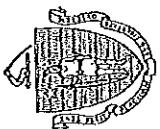
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C. On-Site Review (continued)

Deep Observation Hole Number:

Lot #8, ROAD C 3+00

Additional Notes:



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C. On-Site Review (continued)

Deep Observation Hole Number:

DTH#7 ROAD C

Additional Notes:

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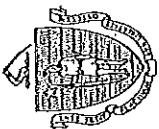


C. On-Site Review (continued)

Deep Observation Hole Number:
Lot#9, ROAD C 5+00

Depth (in.)	Soil Horizon/ Layer	Redoximorphic Features (moisture)			Soil Texture (USDA)	Coarse Fragments % by Volume	Soil Structure	Soil Consistency (moist)	Other
		Depth	Color	Percent					
0-6	A				S.L.				
6-18	B				S.L.				
18-52	C1		48"		S.L.				
52-96	C2				S.L.				

Additional Notes:



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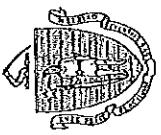
C. On-Site Review (continued)

Deep Observation Hole Number:

DTH#10 ROAD C 8+00

Depth (in.)	Soil Horizon/ Layer	Soil Matrix: Color- Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume	Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent					
0-4	A					S.I.				
4-20	B					S.I.				
20-144	C		60"			S.I.				

Additional Notes:



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C. On-Site Review (continued)

Deep Observation Hole Number:

lot#11, ROAD B 10+00

Depth (in.)	Soil Horizon Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume	Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent					
0-6	A							S.L.		
6-30	B							S.L.		
30-132	C						96"	S.L.		

Additional Notes:



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C. On-Site Review (continued)

Deep Observation Hole Number:

DT#12 ROAD B 12+00

Depth (in.)	Soil Horizon/ Layer	Soil Matrix: Color- Moist (Munsell)	Redoximorphic Features (mottles)		Soil Texture (USDA)	Coarse Fragments % by Volume	Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color					
0-6	A				S.L.				
6-20	B				S.L.				
20-112	C		88"		S.L.				

Additional Notes:



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Form 11 - Soil Suitability A

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

Deep Observation Hole Number:

lot#13, ROAD B 14+00

Depth (in.)	Soil Horizon/ Layer	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
		Depth	Color	Percent		Gravel	Cobbles & Stones			
0-5	A				S.I.					
5-26	B				S.I.					
26-112	C			84"		L.S.				

Additional Notes:



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C. On-Site Review (continued)

Deep Observation Hole Number:

DTH#14 ROAD A 8+00

Depth (in.)	Soil Horizon/ Layer	Soil Matrix: Color- Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume	Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent					
0-5	A					S.L.				
65-24	B					S.L.				
24-144	C		112"			L.S.				

Additional Notes:



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C. On-Site Review (continued)

Deep Observation Hole Number:

lot#15, ROAD A 6+00

Depth (in.)	Soil Horizon/ Layer	Soil Matrix: Color- Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume	Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent					
0-8	A					S.L.				
9-28	B					S.L.				
29-120	C		102"			L.S.				

Additional Notes:



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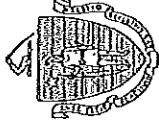
C. On-Site Review (continued)

Deep Observation Hole Number:

DTH#16 ROAD A 4+00

Depth (in.)	Soil Horizon/ Layer	Soil Matrix: Moist (Munsell)	Redoximorphic Features (mottles)		Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color		Percent	Gravel	Cobbles & Stones		
0-6	A				S.L.					
6-30	B				S.L.					
30-144	C		102"		L.S.					

Additional Notes:



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C. On-Site Review (continued)

Deep Observation Hole Number:

lot#17, ROAD A 2+00

Additional Notes



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C. On-Site Review (continued)

Deep Observation Hole Number

DTH#18 ROAD A 1+00

Additional Notes

DRAINAGE ANALYSIS

HydroCAD Calculations – Existing Conditions

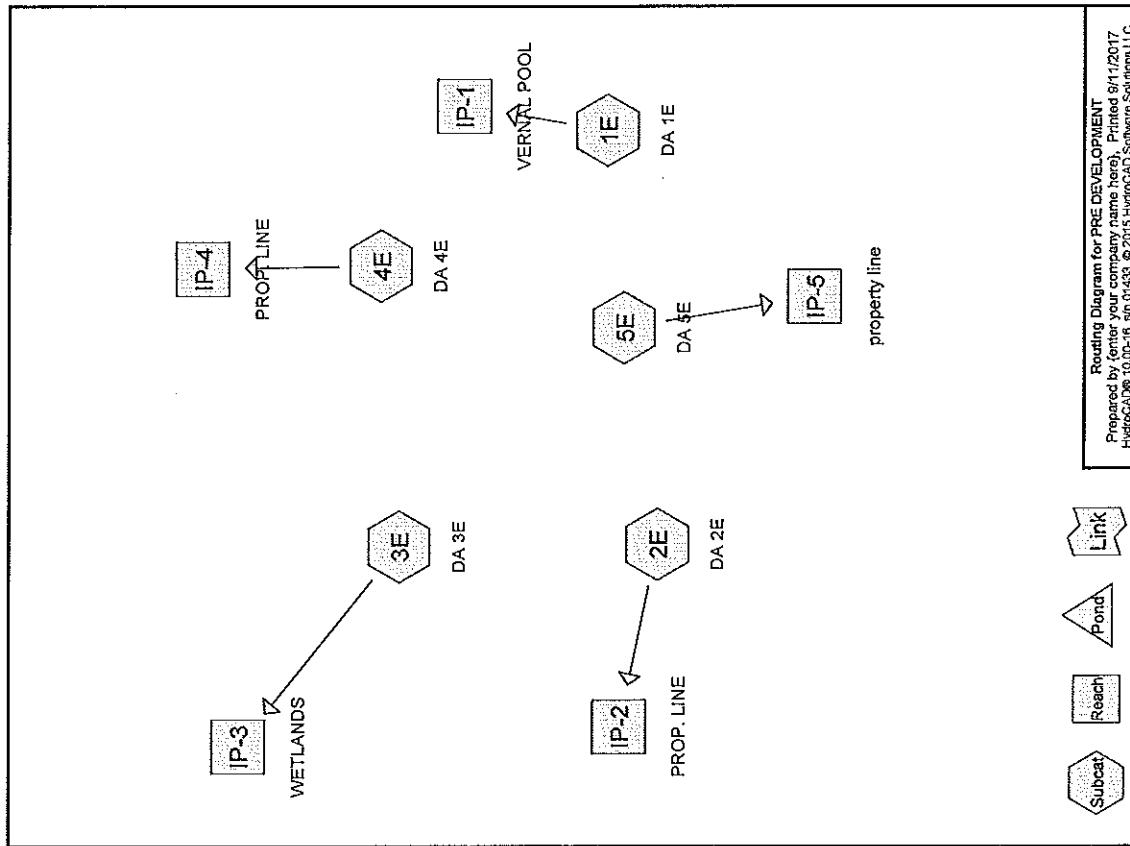
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Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-number)
6.981	61	>75% Grass cover, Good, HSG B (3E, 4E)
0.932	82	Dirt roads, HSG B (1E, 2E)
0.786	98	Paved parking & roofs (3E)
0.275	98	Water Surface, HSG B (4E)
1.782	55	Woods, Good, HSG B (5E)
46.518	58	Woods/grass comb., Good, HSG B (1E, 2E, 3E, 4E)



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Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
56.488	HSG B	1E, 2E, 3E, 4E, 5E
0.000	HSG C	
0.000	HSG D	
0.786	Other	3E

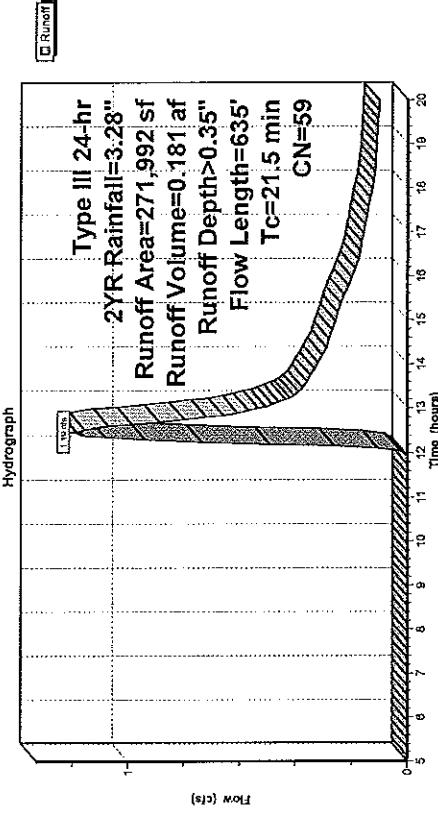
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Type II 24-hr 2YR Rainfall=3.28"
 Runoff by SCS TR-20 method. UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 Type III 24-hr 2YR Rainfall=3.28"

Summary for Subcatchment 1E: DA 1E

Runoff	=	1.19 cfs @ 12.46 hrs, Volume=	0.181 af, Depth> 0.35"		
Runoff by SCS TR-20 method. UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs					
Area (sf)	CN	Description			
263,440	58	Woods/grass comb., Good, HSG B			
8,552	82	Dirt roads, HSG B			
271,992	59	Weighted Average			
271,992		100.00% Pervious Area			
Tc	Length (min)	Slope (feet)	Velocity (ft/sec)	Capacity (cfs)	Description
12.3	50	0.0200	0.07		Sheet Flow, TRAVEL PATH A TO B
9.2	585	0.0450	1.06		Woods; Light Underbrush, n= 0.400 P2= 3.20"
21.5	635	Total			Shallow Concentrated Flow, TRAVEL PATH B TO C Woodland Ku = 5.0 fpm

Subcatchment 1E: DA 1E



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Type III 24-hr 2YR Rainfall=3.28"

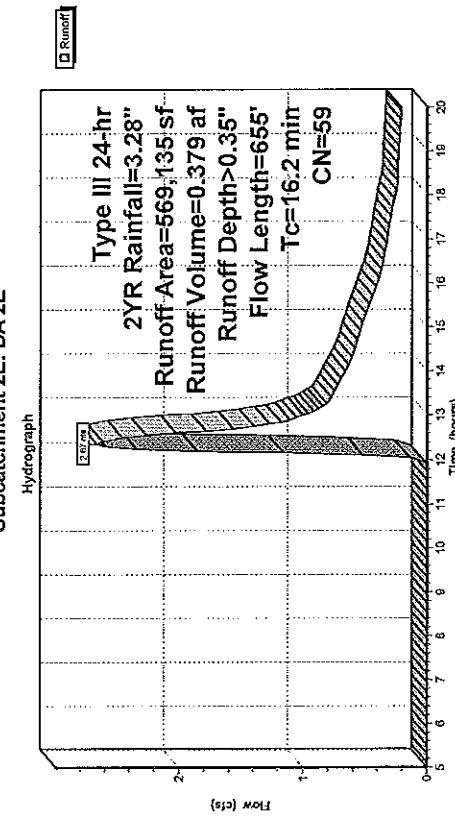
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Summary for Subcatchment 2E: DA 2E

Runoff = 2.67 cfs @ 12.37 hrs, Volume= 0.379 af, Depth> 0.35"
 Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 Type III 24-hr 2YR Rainfall=3.28"

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.9	30	0.0500	0.05	Sheet Flow, TRAVEL PATH A TO B Woods: Dense underbrush n= 0.800 P2= 3.20" Shallow Concentrated Flow, TRAVEL PATH B TO C Woodland Kv= 5.0 fps	
6.3	625	0.1100	1.66		
16.2	655	Total			

Subcatchment 2E: DA 2E



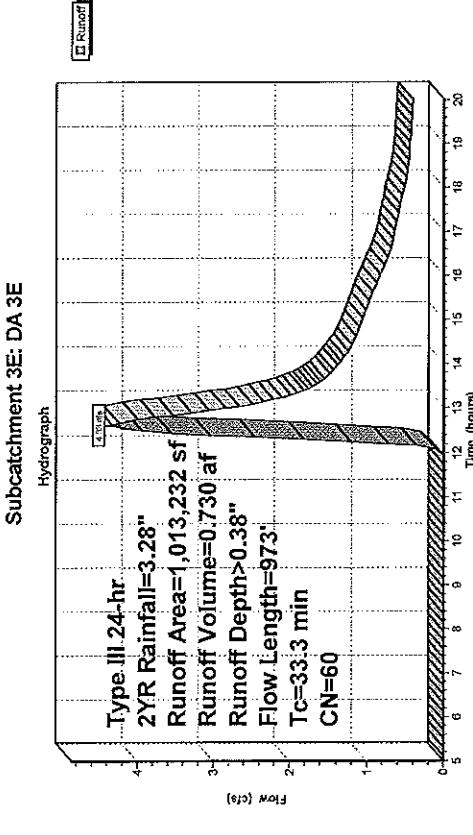
Type III 24-hr 2YR Rainfall=3.28"
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Summary for Subcatchment 3E: DA 3E

Runoff = 4.33 cfs @ 12.62 hrs, Volume= 0.730 af, Depth> 0.38"
 Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 Type III 24-hr 2YR Rainfall=3.28"

Area (sf)	CN	Description
537,109	58	Woods/grass comb., Good, HSG B
32,026	82	Dirt roads-HSG B
569,135	59	Weighted Average
569,135	100	100.00% Perious Area
Tc		
9.9	30	0.0500
6.3	625	0.1100
16.2	655	Total

Subcatchment 3E: DA 3E



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Type III 24-hr 2YR Rainfall=3.28"

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Summary for Subcatchment 4E: DA 4E

Runoff = 1.98 cfs @ 12.70 hrs, Volume= 0.359 af, Depth> 0.34"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2YR Rainfall=3.28"

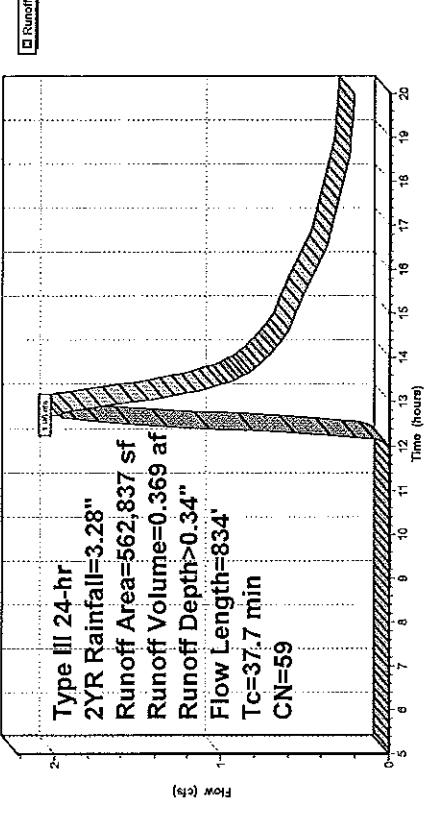
Area (sf)	CN	Description
532,837	58	Woods/grass comb., Good, HSG B
12,000	98	Water Surface, HSG B
18,000	61	>75% Grass cover, Good, HSG B

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
28.3	50	0.0100	0.03	Sheet Flow, TRAVEL PATH A TO B	
9.4	784	0.0770	1.39	Woods: Dense underbrush, n= 0.800 P2= 3.20" Shallow Concentrated Flow, TRAVEL PATH B TO C Woodland Kv= 5.0 fps	

37.7 834 Total

Subcatchment 4E: DA 4E

Hydrograph

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Type III 24-hr 2YR Rainfall=3.28"

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Summary for Subcatchment 5E: DA 5E

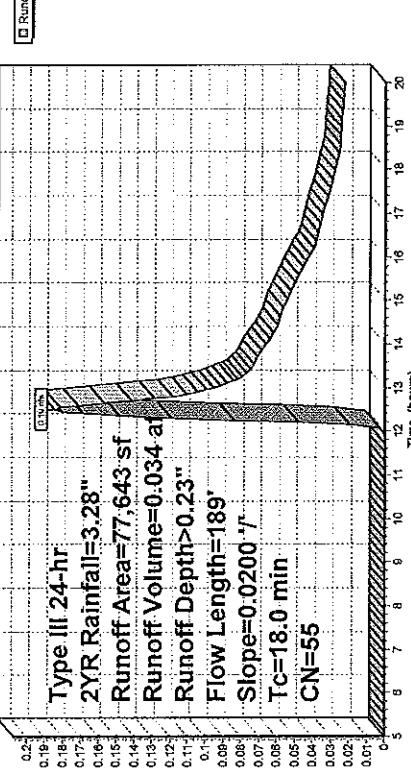
Runoff = 0.19 cfs @ 12.50 hrs, Volume= 0.034 af, Depth> 0.23"

Area (sf)	CN	Description
77,643	55	Woods, Good, HSG B

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.3	30	0.0200	0.04	Sheet Flow, TRAVEL PATH A TO B	
3.7	159	0.0200	0.71	Woods: Dense underbrush, n= 0.800 P2= 3.20" Shallow Concentrated Flow, TRAVEL PATH Woodland Kv= 5.0 fps	

Subcatchment 5E: DA 5E

Hydrograph



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Type III 24-hr 2YR Rainfall=3.28"
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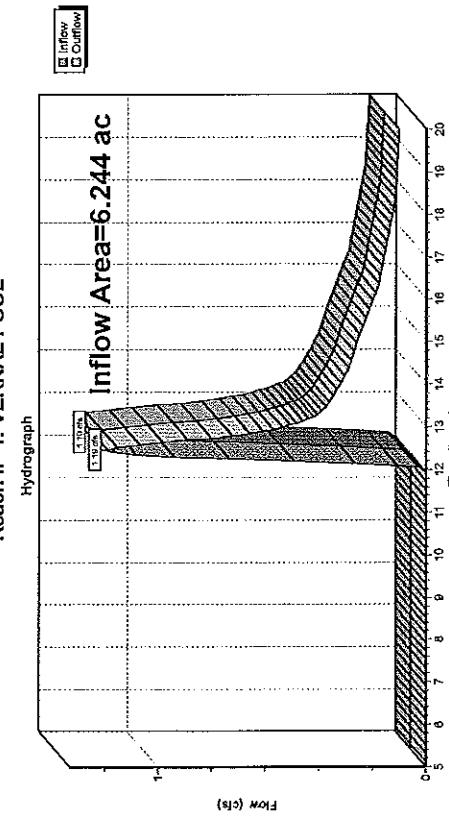
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Summary for Reach IP-1: VERNAL POOL

Inflow Area = 6.244 ac, 0.00% Impervious, Inflow Depth > 0.35" for 2YR event
Inflow = 1.19 cfs @ 12.46 hrs, Volume= 0.181 af
Outflow = 1.19 cfs @ 12.46 hrs, Volume= 0.181 af, Atten= 0%, Lag= 0.0 min
Routing by StoI-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

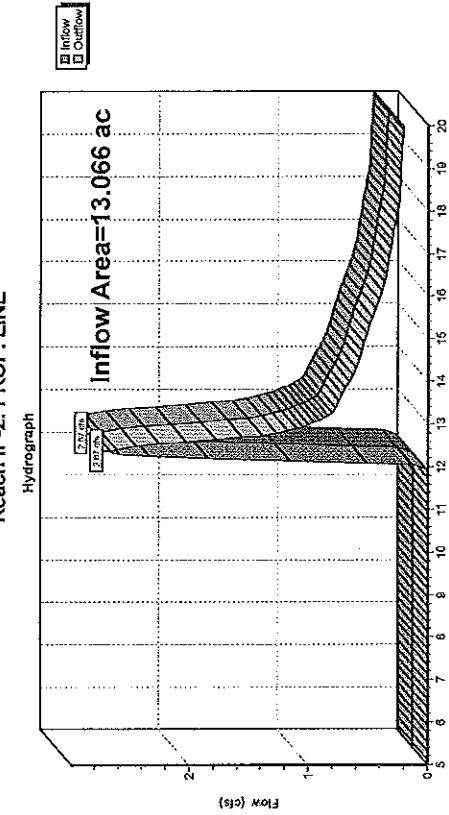
Reach IP-1: VERNAL POOL



Summary for Reach IP-2: PROP. LINE

Inflow Area = 13.066 ac, 0.00% Impervious, Inflow Depth > 0.35" for 2YR event
Inflow = 2.67 cfs @ 12.37 hrs, Volume= 0.379 af
Outflow = 2.67 cfs @ 12.37 hrs, Volume= 0.379 af, Atten= 0%, Lag= 0.0 min
Routing by StoI-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Reach IP-2: PROP. LINE



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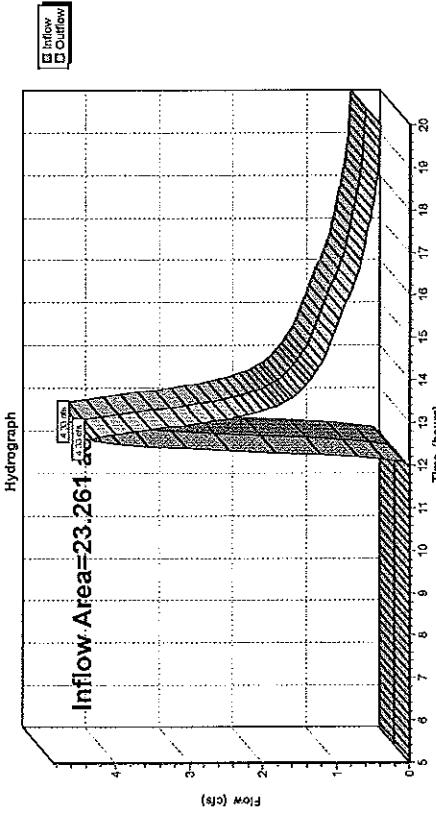
Type III 24-hr 2YR Rainfall=3.28"
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Summary for Reach IP-3: WETLANDS

Inflow Area = 23.261 ac, 3.38% Impervious, Inflow Depth > 0.38" for 2YR event
Inflow = 4.33 cfs @ 12.62 hrs, Volume= 0.730 af
Outflow = 4.33 cfs @ 12.62 hrs, Volume= 0.730 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5:00-20:00 hrs, dt= 0.05 hrs

Reach IP-3: WETLANDS



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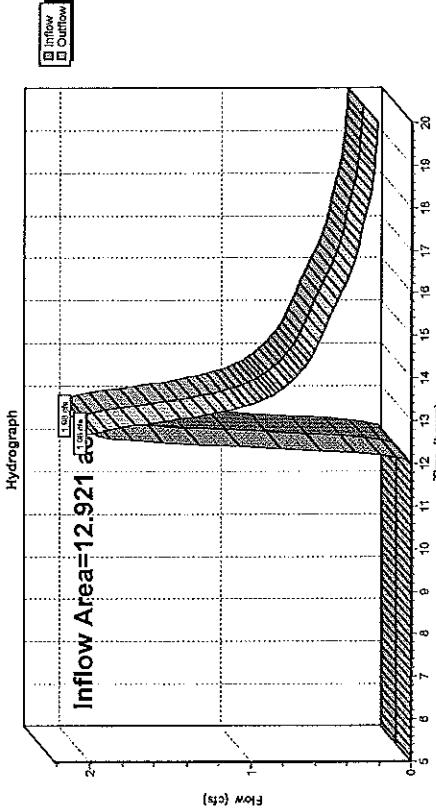
Type III 24-hr 2YR Rainfall=3.28"
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Summary for Reach IP-4: PROP. LINE

Inflow Area = 12.921 ac, 2.13% Impervious, Inflow Depth > 0.34" for 2YR event
Inflow = 1.98 cfs @ 12.70 hrs, Volume= 0.369 af
Outflow = 1.98 cfs @ 12.70 hrs, Volume= 0.369 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5:00-20:00 hrs, dt= 0.05 hrs

Reach IP-4: PROP. LINE



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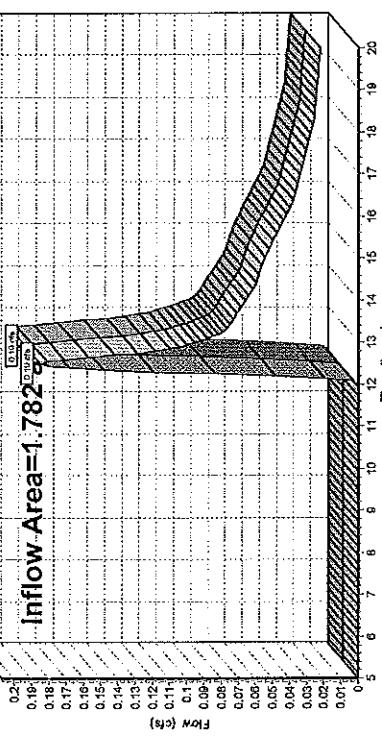
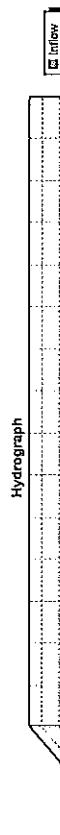
Type III 24-hr 2YR Rainfall=3.28"
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Page 13

Summary for Reach IP-5: property line

Inflow Area = 1.782 ac, 0.00% Impervious, Inflow Depth > 0.23" for 2YR event
 Inflow = 0.19 cfs @ 12.50 hrs, Volume= 0.034 af
 Outflow = 0.19 cfs @ 12.50 hrs, Volume= 0.034 af, Atten= 0%, Lag= 0.0 min

Routing by Star-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Reach IP-5: property line



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Type III 24-hr 10YR Rainfall=4.89"
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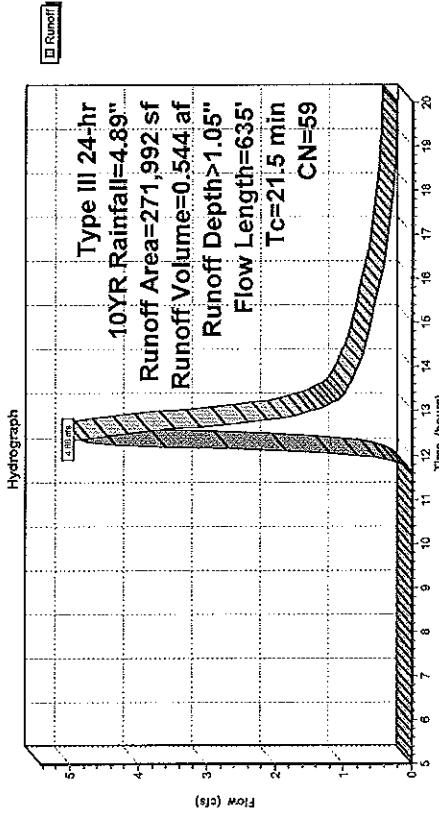
Summary for Subcatchment 1E: DA 1E

Runoff = 4.86 cfs @ 12.35 hrs, Volume= 0.544 af, Depth> 1.05"
 Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 Type III 24-hr 10YR Rainfall=4.89"

Area (sf)	CN	Description
263,440	58	Woods/grass comb., Good, HSG B
8,552	82	Dirt roads, HSG B
271,992	59	Weighted Average
271,992	100.00%	Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.3	50	0.0200	0.07	Sheet Flow, TRAVEL PATH A TO B	
9.2	585	0.0450	1.06	P2= 3.20"	
21.5	635	Total		Shallow Concentrated Flow, TRAVEL PATH B TO C	
					Woods, Light Underbrush n= 0.400 Woodland Ky= 5.0 fps

Subcatchment 1E: DA 1E



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Type III 24-hr 10YR Rainfall=4.89"
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Summary for Subcatchment 2E: DA 2E

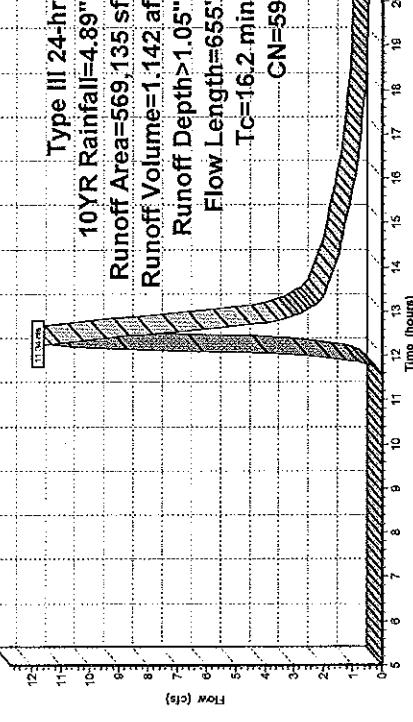
Runoff = 11.34 cfs @ 12:26 hrs. Volume= 1.142 af. Depth> 1.05"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 Type III 24-hr 10YR Rainfall=4.89"

Area (sf)	CN	Description			
537,109	58	Woods/grass comb., Good, HSG B			
32,026	82	Dirt roads..HSG B			
569,135	59	Weighted Average			
569,135		100.00% PerVIOUS Area			
Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.9	30	0.0500	0.05	Sheet Flow, TRAVEL PATH A TO B	
				Woods: Dense underbrush n= 0.800	
				P2= 3.20"	
6.3	625	0.1100	1.66	Shallow Concentrated Flow, TRAVEL PATH B TO C	
				Woodland Kv= 5.0 fpm	
16.2	655	Total			

Subcatchment 2E: DA 2E

Hydrograph



Summary for Subcatchment 3E: DA 3E

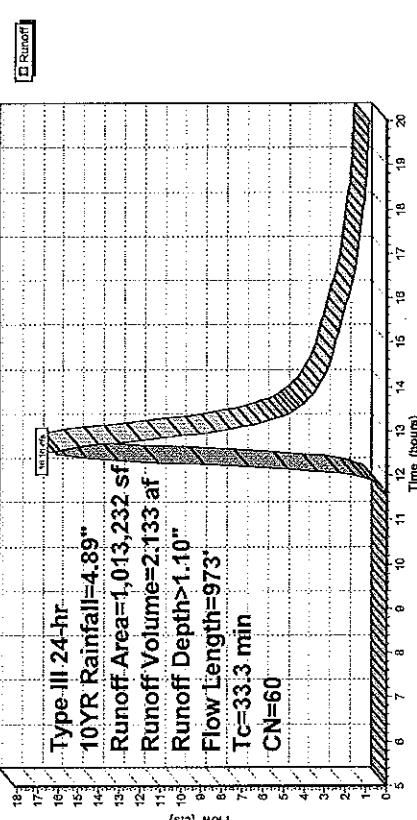
Runoff = 16.16 cfs @ 12:53 hrs. Volume= 2.133 af, Depth> 1.10"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 Type III 24-hr 10YR Rainfall=4.89"

Area (sf)	CN	Description			
692,936	58	Woods/grass comb., Good, HSG B			
34,219	98	Paved parking & roofs			
286,077	61	>75% Grass cover, Good, HSG B			
1,013,232	60	Weighted Average			
979,013		96.62% PerVIOUS Area			
34,219		3.38% Imperious Area			
Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
21.5	50	0.0200	0.04	Sheet Flow, TRAVEL PATH A TO B	
				Woods: Dense underbrush n= 0.800	
				P2= 3.20"	
10.5	777	0.0610	1.23	Shallow Concentrated Flow, TRAVEL PATH B TO C	
1.3	146	0.0360	1.90	Woodland Kv= 5.0 fpm	
33.3	973	Total		Shallow Concentrated Flow, TRAVEL PATH C TO D	
				Nearly Bare & Untilled Kv= 10.0 fpm	

Subcatchment 3E: DA 3E

Hydrograph



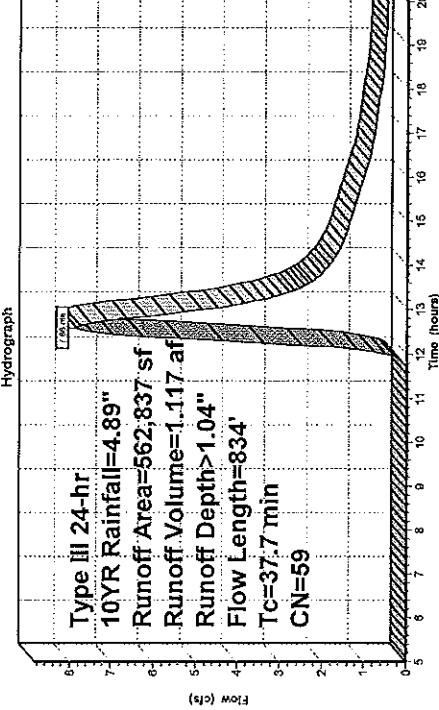
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Type III 24-hr 10YR Rainfall=4.89"
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Summary for Subcatchment 4E: DA 4E

Runoff	=	7.88 cfs @ 12.60 hrs, Volume=	1.117 af, Depth> 1.04"
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs			
Type III 24-hr 10YR Rainfall=4.89"			
Area (sf)	CN	Description	
532,837	58	Woods/grass comb., Good, HSG B	
12,000	98	Water Surface, HSG B	
18,000	61	>75% Grass cover, Good, HSG B	
562,837	59	Weighted Average	
550,837	97.87%	Pervious Area	
12,000	2.13%	Impervious Area	
Tc	Length	Slope	Capacity
(min)	(feet)	(ft/ft)	(cfs)
28.3	50	0.0100	0.03
9.4	784	0.0770	1.39
37.7	834	Total	

Subcatchment 4E: DA 4E



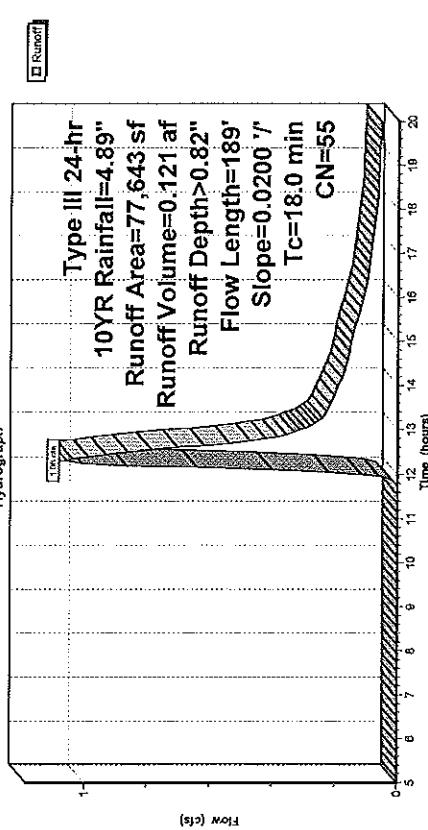
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Type III 24-hr 10YR Rainfall=4.89"
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Summary for Subcatchment 5E: DA 5E

Runoff	=	1.06 cfs @ 12.31 hrs, Volume=	0.121 af, Depth> 0.82"
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs			
Type III 24-hr 10YR Rainfall=4.89"			
Area (sf)	CN	Description	
77,643	55	Woods, Good, HSG B	
77,643	100.00%	Pervious Area	
Tc	Length	Slope	Capacity
(min)	(feet)	(ft/ft)	(cfs)
14.3	30	0.0200	0.04
3.7	159	0.0200	0.71
18.0	189	Total	

Subcatchment 5E: DA 5E

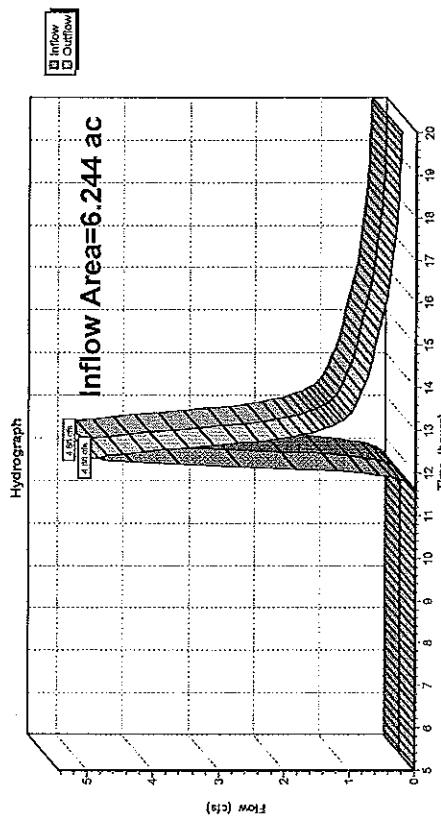


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Type III 24-hr 10YR Rainfall=4.89"
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Inflow Area = 6.244 ac, 0.00% Impervious, Inflow Depth > 1.05" for 10YR event
Inflow = 4.86 cfs @ 12.35 hrs, Volume= 0.544 af
Outflow = 4.86 cfs @ 12.35 hrs, Volume= 0.544 af, Atten= 0%, Lag= 0.0 min
Routing by Sto-Imp+Trans method, Time Span= 5:00-20:00 hrs, dt= 0.05 hrs

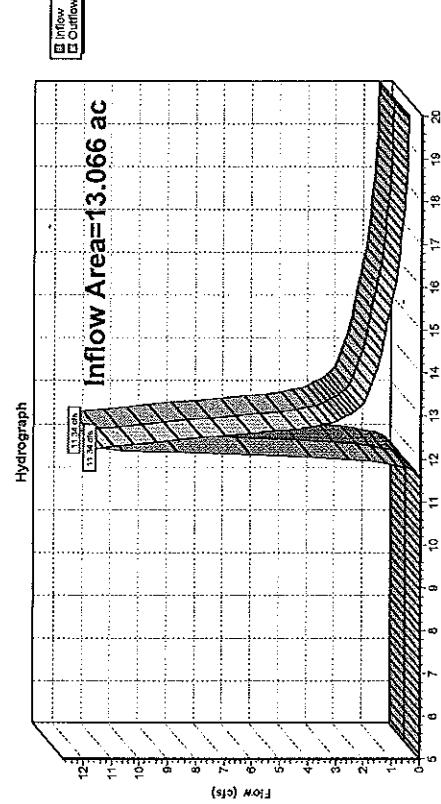
Reach IP-1: VERNAL POOL



Type III 24-hr 10YR Rainfall=4.89"
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Inflow Area = 13.066 ac, 0.00% Impervious, Inflow Depth > 1.05" for 10YR event
Inflow = 11.34 cfs @ 12.26 hrs, Volume= 1.142 af
Outflow = 11.34 cfs @ 12.26 hrs, Volume= 1.142 af, Atten= 0%, Lag= 0.0 min
Routing by Sto-Imp+Trans method, Time Span= 5:00-20:00 hrs, dt= 0.05 hrs

Reach IP-2: PROP. LINE



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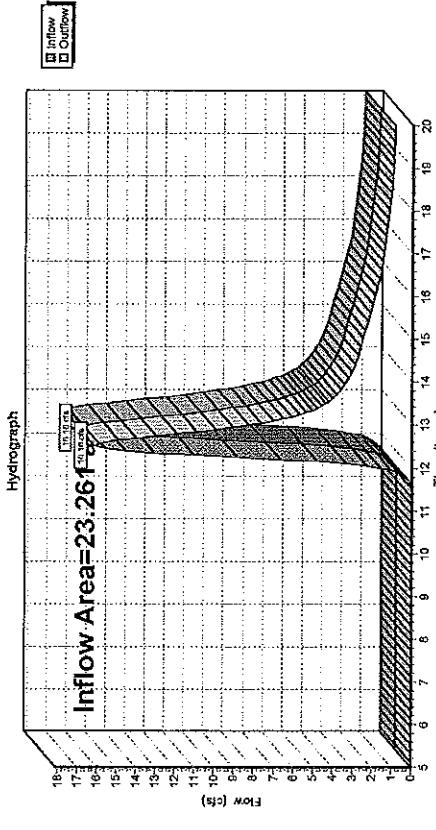
Type III 24-hr 10YR Rainfall=4.89"
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Summary for Reach IP-3: WETLANDS

Inflow Area = 23.261 ac, 3.38% Impervious, Inflow Depth > 1.10" for 10YR event
Inflow = 16.16 cfs @ 12.53 hrs, Volume= 2.133 af
Outflow = 16.16 cfs @ 12.53 hrs, Volume= 2.133 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5:00-20:00 hrs, dt= 0.05 hrs

Reach IP-3: WETLANDS



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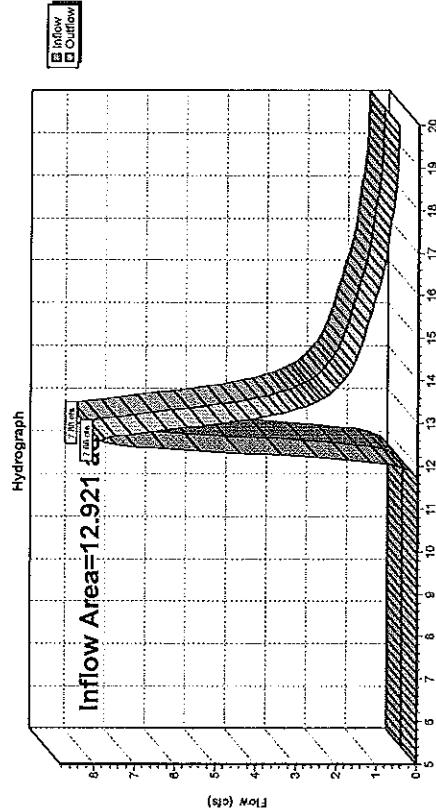
Type III 24-hr 10YR Rainfall=4.89"
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Summary for Reach IP-4: PROP. LINE

Inflow Area = 12.921 ac, 2.13% Impervious, Inflow Depth > 1.04" for 10YR event
Inflow = 7.88 cfs @ 12.60 hrs, Volume= 1.117 af
Outflow = 7.88 cfs @ 12.60 hrs, Volume= 1.117 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5:00-20:00 hrs, dt= 0.05 hrs

Reach IP-4: PROP. LINE



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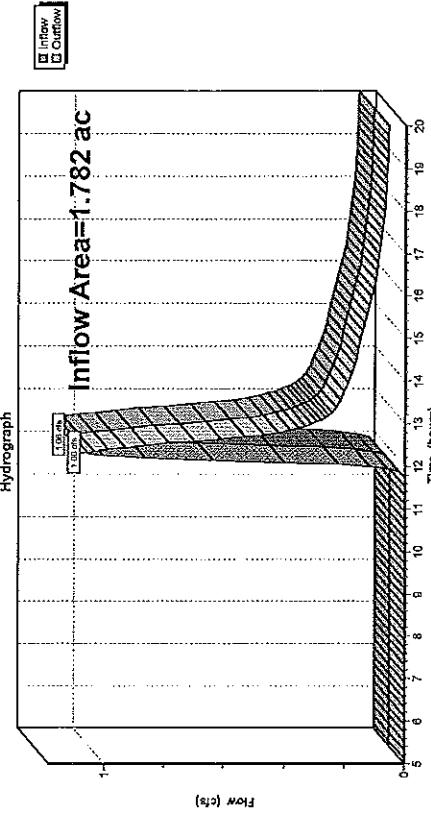
Type III 24-hr 10YR Rainfall=4.89"
 Printed 9/11/2017
 Page 23

Summary for Reach IP-5: property line

Inflow Area = 1.782 ac, 0.00% Impervious, Inflow Depth > 0.82" for 10YR event
 Inflow = 1.06 cfs @ 12.31 hrs, Volume= 0.121 af
 Outflow = 1.06 cfs @ 12.31 hrs, Volume= 0.121 af, Atten= 0%, Lag= 0.0 min

Routing by Star-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Reach IP-5: property line



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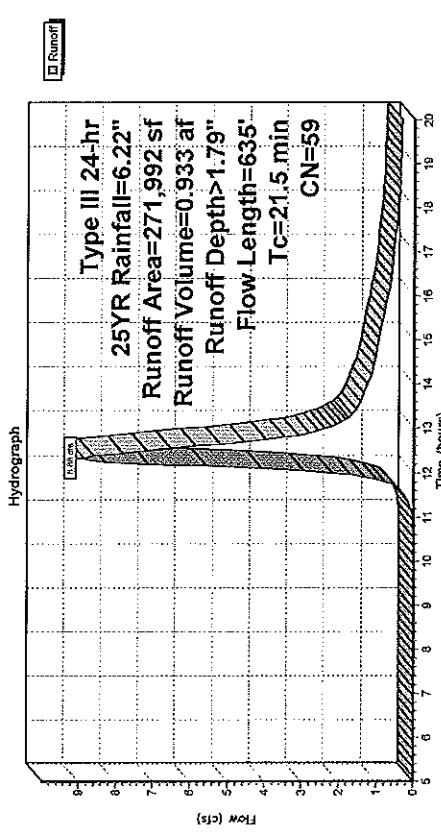
Summary for Subcatchment 1E: DA 1E

Runoff = 8.88 cfs @ 12.32 hrs, Volume= 0.933 af, Depth> 1.79"
 Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 Type II 24-hr 25YR Rainfall=6.22"

Area (sf)	CN	Description
263,440	58	Woods/grass comb, Good, HSG B
8,532	82	Dirt roads, HSG B
271,982	59	Weighted Average
271,982		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.3	50	0.0200	0.07	Sheet Flow, TRAVEL PATH A TO B	
					Woods; Light underbrush, n= 0.400
					P2= 3.28"
					Shallow Concentrated Flow, TRAVEL PATH B TO C
					Woodland Kv= 5.0 cfs

Subcatchment 1E: DA 1E



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Type III 24-hr 25YR Rainfall=6.22"

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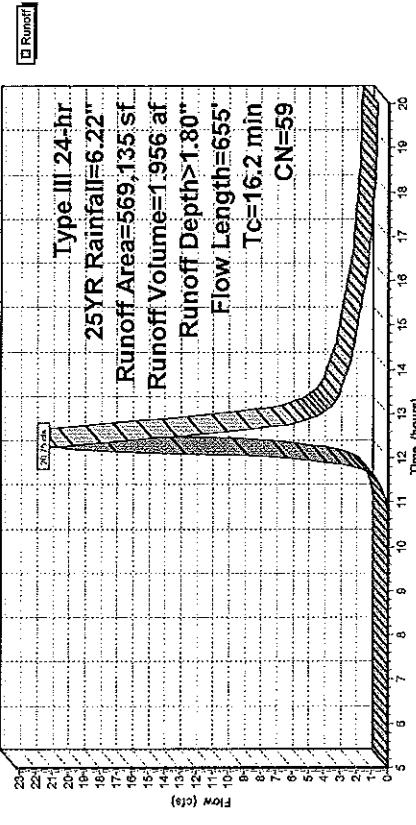
Page 26

Summary for Subcatchment 2E: DA 2E

Runoff = 20.75 cfs @ 12:25 hrs. Volume=

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 Type III 24-hr 25YR Rainfall=6.22"

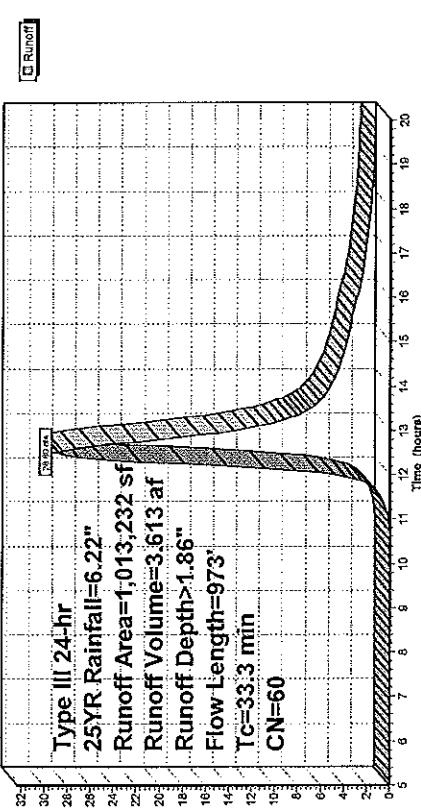
Area (sf)	CN	Description			
537,109	58	Woods/grass comb., Good, HSG B			
32,026	82	Dirt roads, HSG B			
569,135	59	Weighted Average			
569,135	100.00%	Previous Area			
Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.9	30	0.0500	0.05	Sheet Flow, TRAVEL PATH A TO B Woods: Dense underbrush n= 0.800 P2= 3.20" Shallow Concentrated Flow, TRAVEL PATH B TO C Woodland Kv= 5.0 fps	
6.3	625	0.1100	1.66		
16.2	655	Total			

Subcatchment 2E: DA 2E**Hydrograph****Summary for Subcatchment 3E: DA 3E**

Runoff = 28.80 cfs @ 12:50 hrs. Volume=

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 Type III 24-hr 25YR Rainfall=6.22"

Area (sf)	CN	Description			
692,936	58	Woods/grass comb., Good, HSG B			
34,219	98	Paved parking & roofs			
285,077	61	>75% Grass cover, Good, HSG B			
1,013,232	60	Weighted Average			
979,013	96.62%	Pervious Area			
34,219	3.38%	Impervious Area			
Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
21.5	50	0.0200	0.04	Sheet Flow, TRAVEL PATH A TO B Woods: Dense underbrush n= 0.800 P2= 3.20" Shallow Concentrated Flow, TRAVEL PATH B TO C Woodland Kv= 5.0 fps	
10.5	777	0.0610	1.23		
1.3	146	0.0360	1.90		
33.3	973	Total			

Subcatchment 3E: DA 3E**Hydrograph**

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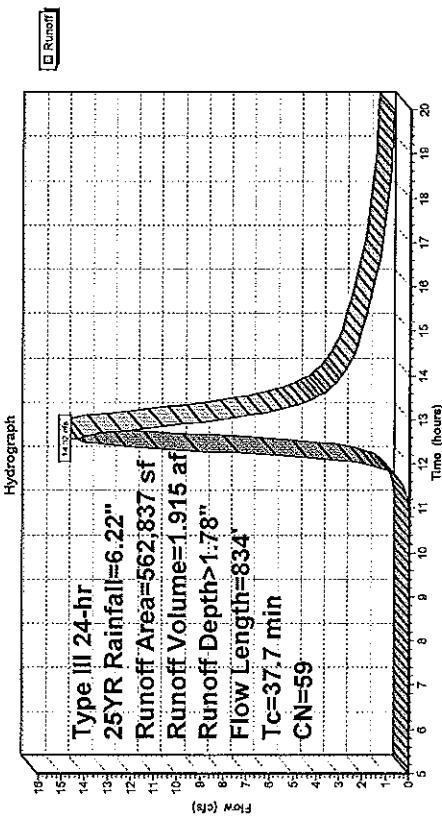
Type III 24-hr 25YR Rainfall=6.22"
 Printed 9/11/2017
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Summary for Subcatchment 4E: DA 4E

Runoff = 14.32 cfs @ 12.57 hrs, Volume= 1.915 af, Depth> 1.78"
 Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 Type III 24-hr 25YR Rainfall=6.22"

Area (sf)	CN	Description			
532,837	58	Woods/grass comb., Good, HSG B			
12,000	98	Water Surface, HSG B			
18,000	61	>75% Grass cover, Good, HSG B			
562,837	59	Weighted Average			
550,837	97.87%	Pervious Area			
12,000	2.13%	Impervious Area			
Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
28.3	50	0.0100	0.03	Sheet Flow, TRAVEL PATH A TO B	
				Woods: Dense underbrush n=0.800 P2=3.20"	
9.4	784	0.0770	1.39	Shallow Concentrated Flow, TRAVEL PATH B TO C	
				Woodland Kv= 5.0 fps	
37.7	834	Total			

Subcatchment 4E: DA 4E



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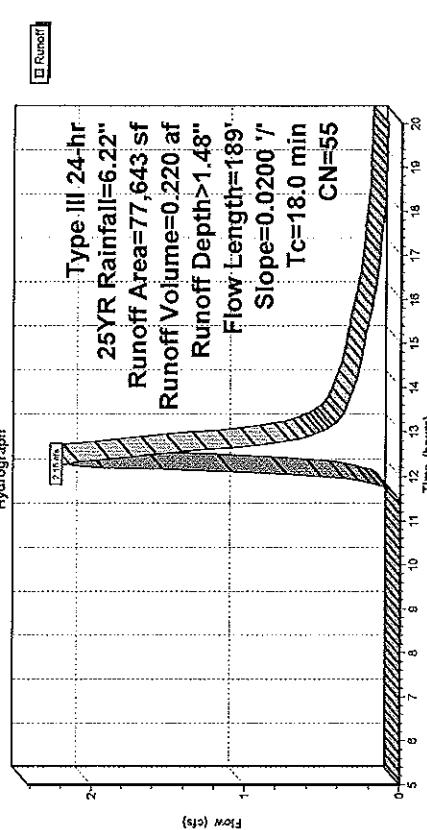
Type III 24-hr 25YR Rainfall=6.22"
 Printed 9/11/2017
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Summary for Subcatchment 5E: DA 5E

Runoff = 2.15 cfs @ 12.28 hrs, Volume= 0.220 af, Depth> 1.48"
 Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 Type III 24-hr 25YR Rainfall=6.22"

Area (sf)	CN	Description			
77,643	55	Woods, Good, HSG B			
77,643	100.00%	Pervious Area			
Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.3	30	0.0200	0.04	Sheet Flow, TRAVEL PATH A TO B	
				Woods: Dense underbrush n=0.800 P2=3.20"	
3.7	159	0.0200	0.77	Shallow Concentrated Flow, TRAVEL PATH	
				Woodland Kv= 5.0 fps	
18.0	189	Total			

Subcatchment 5E: DA 5E



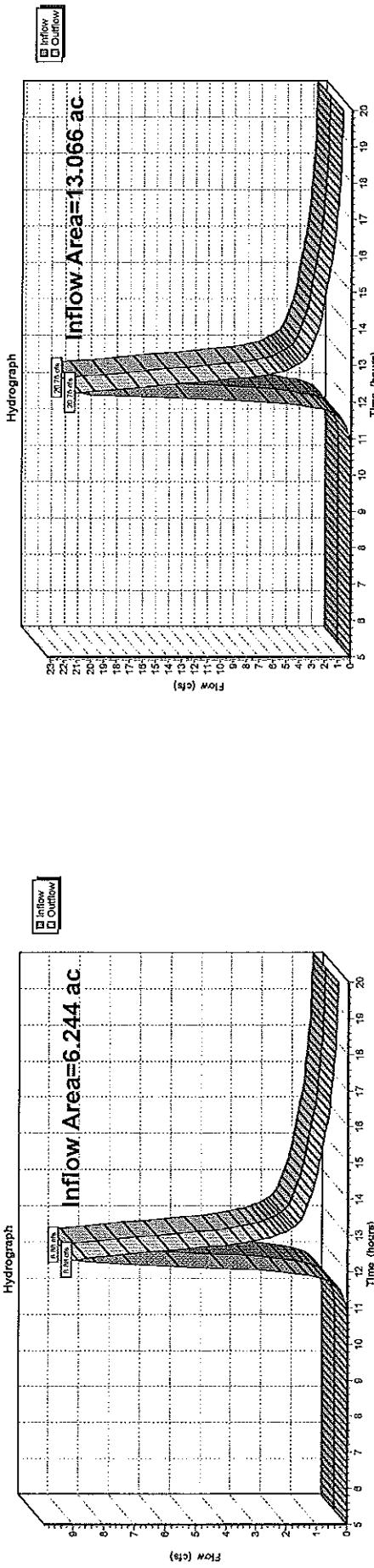
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Type III 24-hr 25YR Rainfall=6.22"
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Summary for Reach IP-1: VERNAL POOL

Inflow Area = 6.244 ac, 0.00% Impervious, Inflow Depth > 1.79" for 25YR event
 Inflow = 8.88 cfs @ 12.32 hrs, Volume= 0.933 af
 Outflow = 8.88 cfs @ 12.32 hrs, Volume= 0.933 af, Atten= 0%, Lag= 0.0 min
 Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Reach IP-1: VERNAL POOL



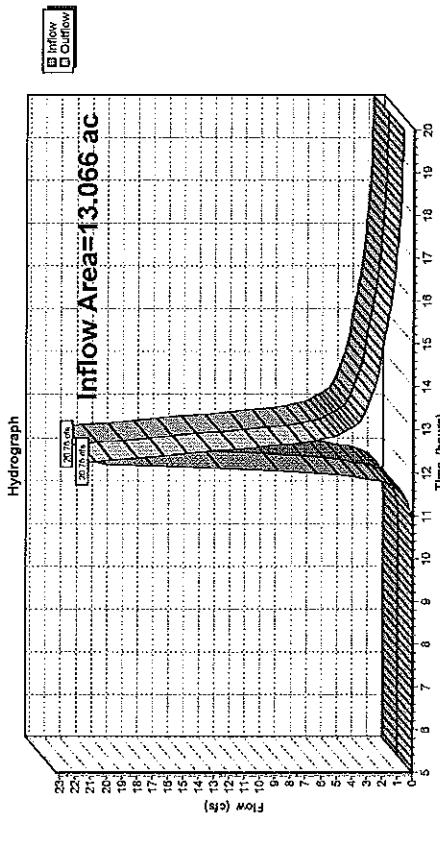
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Type III 24-hr 25YR Rainfall=6.22"
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Summary for Reach IP-2: PROP. LINE

Inflow Area = 13.066 ac, 0.00% impervious, Inflow Depth > 1.80" for 25YR event
 Inflow = 20.75 cfs @ 12.25 hrs, Volume= 1.556 af
 Outflow = 20.75 cfs @ 12.25 hrs, Volume= 1.556 af, Atten= 0%, Lag= 0.0 min
 Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Reach IP-2: PRO. LINE



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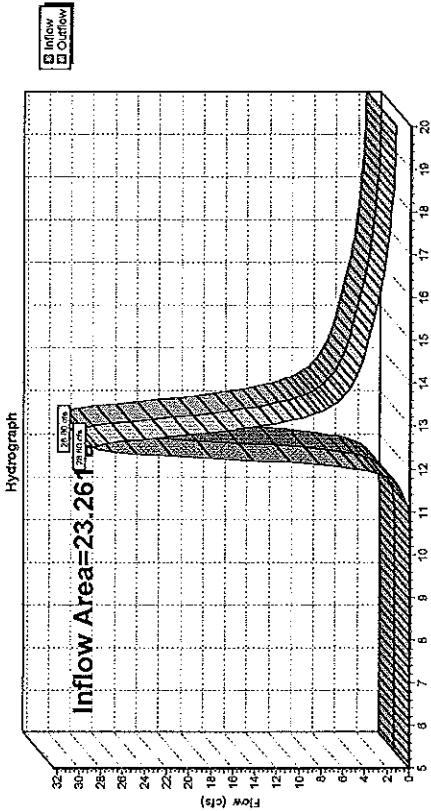
Type III 24-hr 25YR Rainfall=6.22"
Printed 9/11/2017
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Summary for Reach IP-3: WETLANDS

Inflow Area = 23.261 ac, 3.38% Impervious, Inflow Depth > 1.86" for 25YR event
Inflow = 28.80 cfs @ 12.50 hrs, Volume= 3.613 af
Outflow = 28.80 cfs @ 12.50 hrs, Volume= 3.613 af, Atten= 0%, Lag= 0.0 min

Routing by StoR-Ind+Trans method, Time Span= 5:00-20:00 hrs, dt= 0.05 hrs

Reach IP-3: WETLANDS



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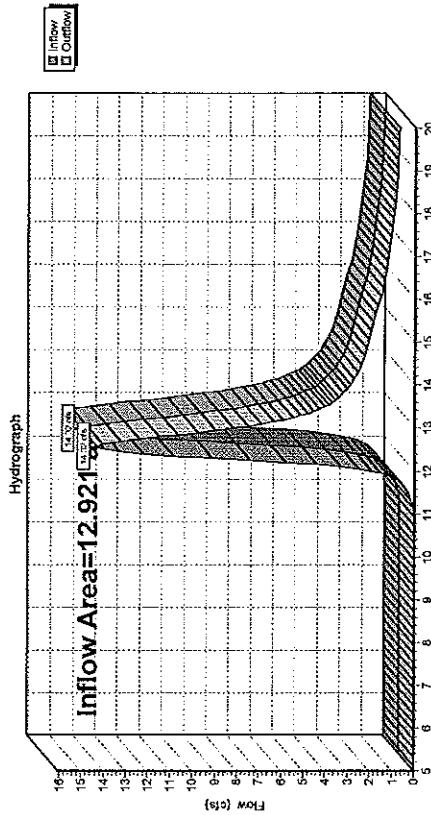
Type III 24-hr 25YR Rainfall=6.22"
Printed 9/11/2017
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Summary for Reach IP-4: PROP. LINE

Inflow Area = 12.921 ac, 2.113% Impervious, Inflow Depth > 1.78" for 25YR event
Inflow = 14.32 cfs @ 12.57 hrs, Volume= 1.915 af
Outflow = 14.32 cfs @ 12.57 hrs, Volume= 1.915 af, Atten= 0%, Lag= 0.0 min

Routing by StoR-Ind+Trans method, Time Span= 5:00-20:00 hrs, dt= 0.05 hrs

Reach IP-4: PROP. LINE



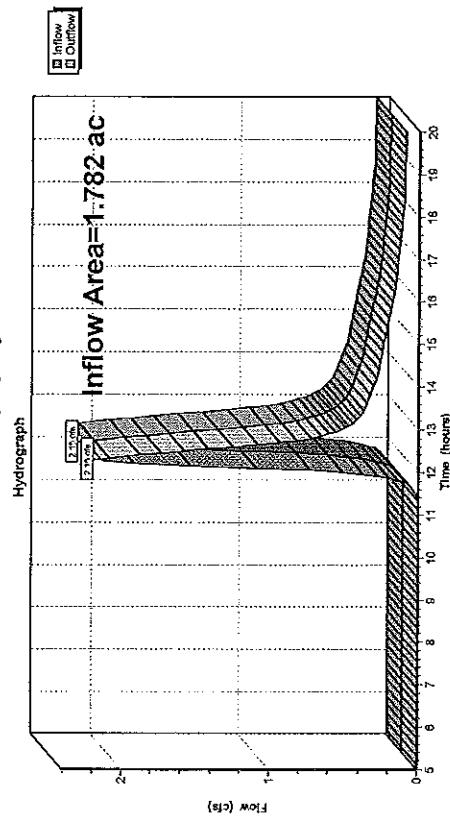
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Type III 24-hr 25YR Rainfall=6.62"
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Summary for Reach IP-5: property line

Inflow Area = 1.782 ac, 0.00% Impervious, Inflow Depth > 1.48" for 25YR event
 Inflow = 2.15 cfs @ 12.28 hrs, Volume= 0.220 af
 Outflow = 2.15 cfs @ 12.28 hrs, Volume= 0.220 af, Atten= 0%, Lag= 0.0 min
 Routing by Sto-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Reach IP-5: property line



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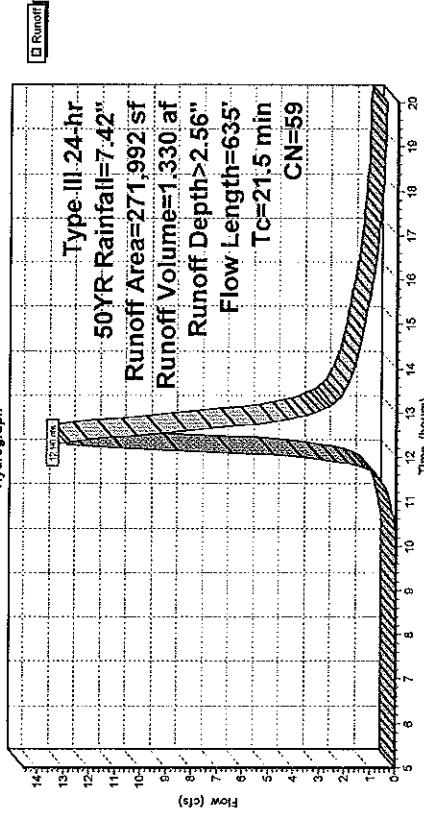
Type III 24-hr 50YR Rainfall=7.42"
 Printed 9/11/2017
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Summary for Subcatchment 1E: DA 1E

Runoff = 12.96 cfs @ 12.32 hrs, Volume= 1.330 af, Depth> 2.56"
 Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 Type III 24-hr 50YR Rainfall=7.42"

Area (sf)	CN	Description	
263,440	58	Woods/grass comb., Good, HSG B	
8,552	82	Dirt roads, HSG B	
271,992	59	Weighted Average	
271,992		100.00% Previous Area	
Tc (min)	Length (feet)	Slope Capacity (ft/sec)	Description
12.3	50	0.0200	0.07 Sheet Flow, TRAVEL PATH A TO B
9.2	585	0.0450	1.06 Woods: Light Underbrush n= 0.400 P2= 3.20"
21.5	635 Total		Shallow Concentrated Flow, TRAVEL PATH B TO C
			Woodland Kv= 5.0 fps

Subcatchment 1E: DA 1E



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Type III 24-hr 50YR Rainfall=7.42"
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Type III 24-hr 50YR Rainfall=7.42"
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Summary for Subcatchment 2E: DA 2E

Runoff = 30.28 cfs @ 12:24 hrs. Volume = 2.788 af. Depth> 2.56"

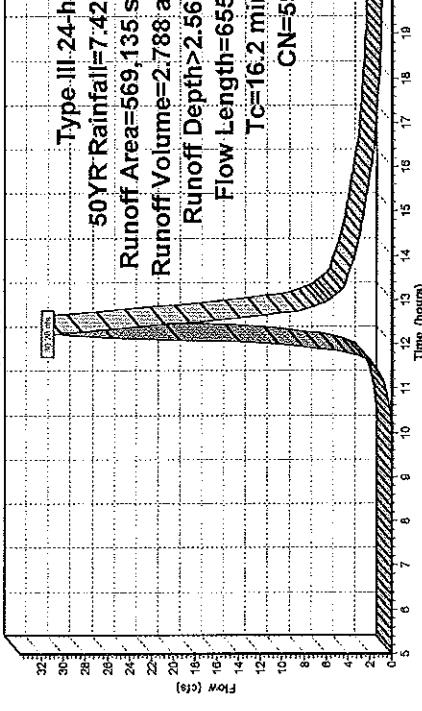
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 50YR Rainfall=7.42"

Area (sf)	CN	Description
537,109	58	Woods/grass comb., Good, HSG B
32,026	82	Dirt roads, HSG B
569,135	59	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.9	30	0.0500	0.05	Sheet Flow, TRAVEL PATH A TO B Woods: Dense underbrush n = 0.800 P2= 3.20" Shallow Concentrated Flow, TRAVEL PATH B TO C Woodland Kv= 5.0 fps	
6.3	625	0.1100	1.66		
16.2	655	Total			

Subcatchment 2E: DA 2E

Hydrograph



Type III 24-hr 50YR Rainfall=7.42"
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Type III 24-hr 50YR Rainfall=7.42"
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Summary for Subcatchment 3E: DA 3E

Runoff = 41.53 cfs @ 12:49 hrs. Volume = 5.118 af, Depth> 2.64"
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 50YR Rainfall=7.42"

Runoff = 41.53 cfs @ 12:49 hrs. Volume = 5.118 af, Depth> 2.64"

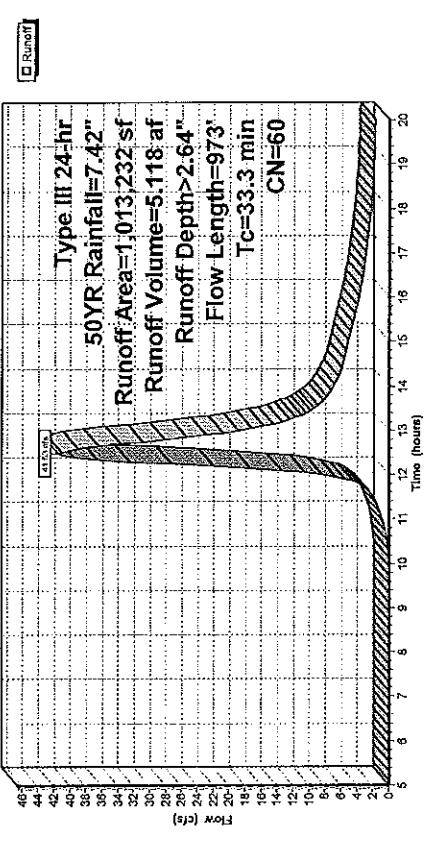
Area (sf)	CN	Description
692,936	58	Woods/grass comb., Good, HSG B
34,219	98	Paved parking & roofs
286,077	61	>75% Grass cover, Good, HSG B

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
21.5	50	0.0200	0.04	Sheet Flow, TRAVEL PATH A TO B Woods: Dense underbrush n= 0.800 P2= 3.20" Shallow Concentrated Flow, TRAVEL PATH B TO C Woodland Kv= 5.0 fps	
10.5	777	0.0610	1.23		
1.3	146	0.0360	1.90		Shallow Concentrated Flow, TRAVEL PATH C TO D Nearly Bare & Untilled Kv= 10.0 fps

33.3 973 Total

Subcatchment 3E: DA 3E

Runoff = 41.53 cfs @ 12:49 hrs. Volume = 5.118 af, Depth> 2.64"



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Type III 24-hr 50YR Rainfall=7.42"
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Summary for Subcatchment 4E: DA 4E

Runoff = 20.86 cfs @ 12.55 hrs, Volume= 2.732 af, Depth> 2.54"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 Type III 24-hr 50YR Rainfall=7.42"

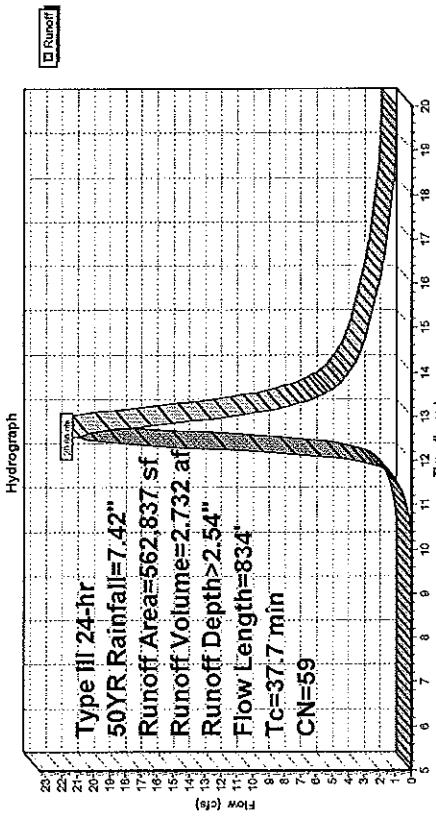
Area (sf)	CN	Description
532,837	58	Wood/grass comb., Good, HSG B
12,000	98	Water Surface, HSG B
18,000	61	>75% Grass cover, Good, HSG B

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
28.3	50	0.0100	0.03	Sheet Flow, TRAVEL PATH A TO B	

Woods: Dense underbrush n= 0.800 P2= 3.20"
 Shallow Concentrated Flow, TRAVEL PATH B TO C
 Woodland Kv= 5.0 cfs

37.7 Total

Subcatchment 4E: DA 4E



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Type III 24-hr 50YR Rainfall=7.42"
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Summary for Subcatchment 5E: DA 5E

Runoff = 3.30 cfs @ 12.27 hrs, Volume= 0.323 af, Depth> 2.17"

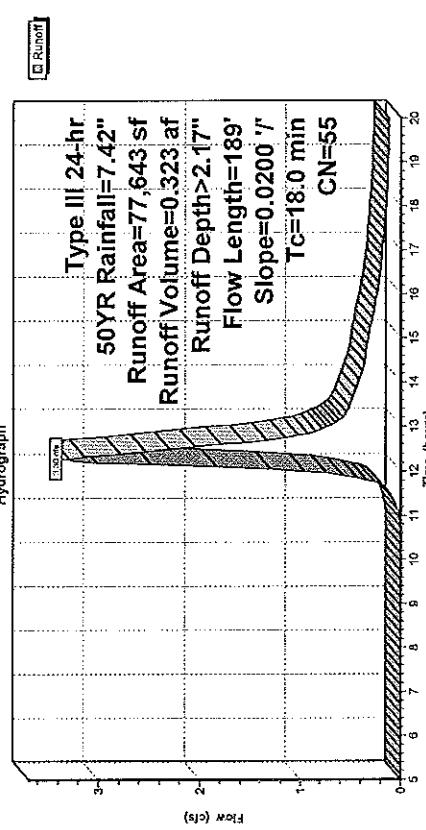
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 Type III 24-hr 50YR Rainfall=7.42"

Area (sf)	CN	Description
77,643	55	Woods, Good, HSG B
77,643	100.00%	Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.3	30	0.0200	0.04	Sheet Flow, TRAVEL PATH A TO B	
3.7	159	0.0200	0.71	Woods: Dense underbrush n= 0.800 P2= 3.20" Shallow Concentrated Flow, TRAVEL PATH Woodland Kv= 5.0 cfs	

18.0 189 Total

Subcatchment 5E: DA 5E



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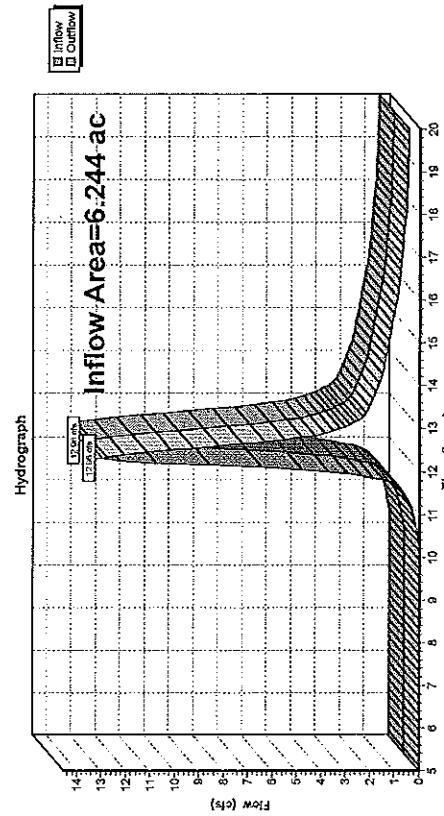
Type III 24-hr 50YR Rainfall=7.42"
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Page 40

Summary for Reach IP-1: VERNAL POOL

Inflow Area = 6.244 ac, 0.00% Impervious, Inflow Depth > 2.56" for 50YR event
Inflow = 12.96 cfs @ 12.32 hrs, Volume= 1.330 af
Outflow = 12.96 cfs @ 12.32 hrs, Volume= 1.330 af, Atten= 0%, Lag= 0.0 min

Routing by StoI-Ind+Trans method, Time Span= 5:00-20:00 hrs, dt= 0.05 hrs

Reach IP-1: VERNAL POOL

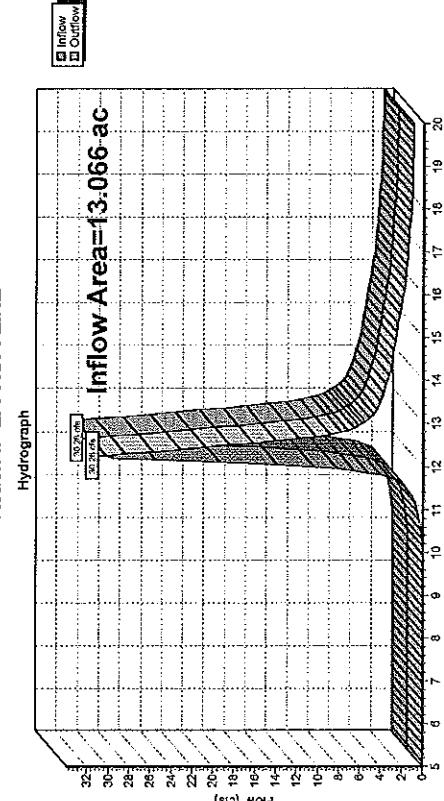


Summary for Reach IP-2: PROP. LINE

Inflow Area = 13.066 ac, 0.00% Impervious, Inflow Depth > 2.56" for 50YR event
Inflow = 30.28 cfs @ 12.24 hrs, Volume= 2.788 af
Outflow = 30.28 cfs @ 12.24 hrs, Volume= 2.788 af, Atten= 0%, Lag= 0.0 min

Routing by StoI-Ind+Trans method, Time Span= 5:00-20:00 hrs, dt= 0.05 hrs

Reach IP-2: PROP. LINE



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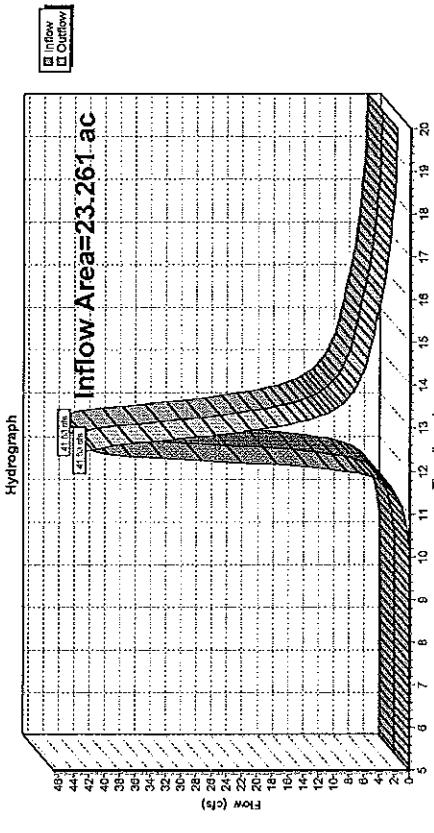
Type III 24-hr 50YR Rainfall=7.42"
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Summary for Reach IP-3: WETLANDS

Inflow Area = 23.261 ac, 3.38% Impervious, Inflow Depth > 2.64" for 50YR event
Inflow = 41.53 cfs @ 12.49 hrs, Volume= 5.118 af
Outflow = 41.53 cfs @ 12.49 hrs, Volume= 5.118 af, Attenuation= 0%, Lag= 0.0 min

Routing by Sto-Ind+Trans method, Time Span= 5:00-20:00 hrs, dt= 0.05 hrs

Reach IP-3: WETLANDS



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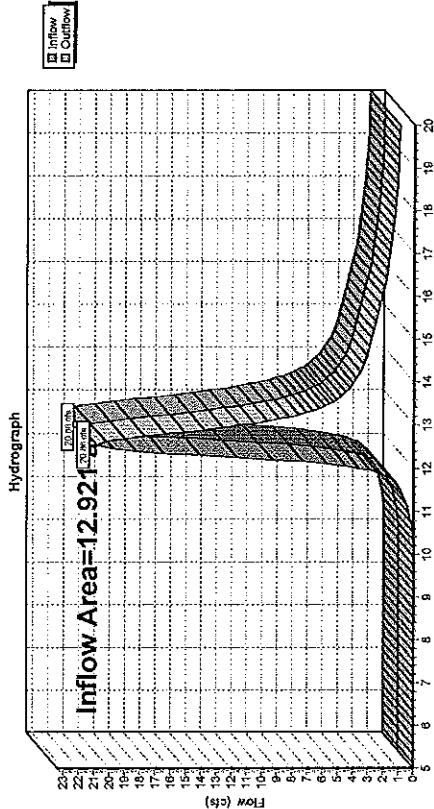
Type III 24-hr 50YR Rainfall=7.42"
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Page 42

Summary for Reach IP-4: PROP. LINE

Inflow Area = 12.921 ac, 2.13% Impervious, Inflow Depth > 2.54" for 50YR event
Inflow = 20.86 cfs @ 12.55 hrs, Volume= 2.732 af
Outflow = 20.86 cfs @ 12.55 hrs, Volume= 2.732 af, Attenuation= 0%, Lag= 0.0 min

Routing by Sto-Ind+Trans method, Time Span= 5:00-20:00 hrs, dt= 0.05 hrs

Reach IP-4: PROP. LINE



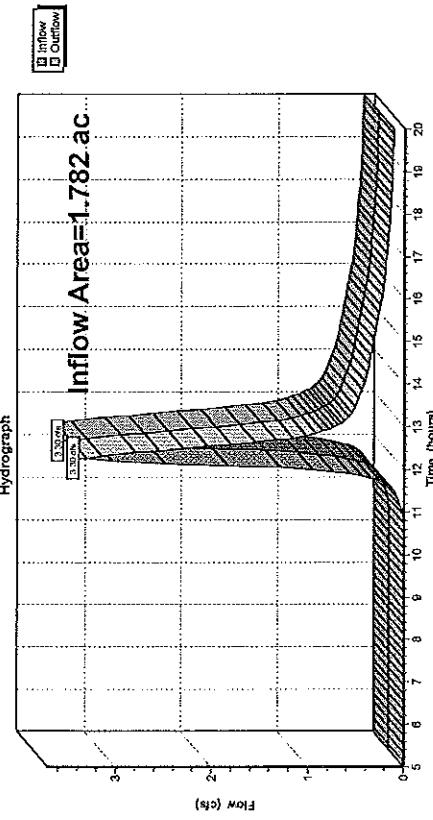
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Type III 24-hr 50YR Rainfall=7.42"
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Summary for Reach IP-5: property line

Inflow Area = 1.782 ac, 0.00% Impervious, Inflow Depth > 2.17" for 50YR event
 Inflow = 3.30 cfs @ 12.27 hrs, Volume= 0.323 af
 Outflow = 3.30 cfs @ 12.27 hrs, Volume= 0.323 af, Atten= 0%, Lag= 0.0 min
 Routing by Sto-Ind+Trans method, Time Span= 5:00-20:00 hrs, dt= 0.05 hrs

Reach IP-5: property line



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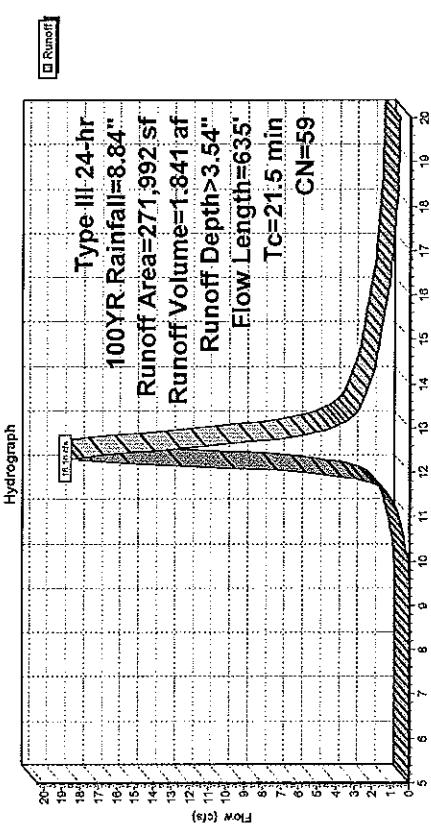
Summary for Subcatchment 1E: DA 1E

Runoff = 18.16 cfs @ 12.31 hrs, Volume= 1.841 af, Depth> 3.54"
 Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5:00-20:00 hrs, dt= 0.05 hrs
 Type III 24-hr 100YR Rainfall=8.84"

Area (sf)	CN	Description
263,440	58	Woods/grass comb., Good, HSG B
8,552	82	Dirt roads, HSG B
271,992	59	Weighted Average
271,992		100.00% Pervious Area
Tc (min)	Length (feet)	Slope (ft/ft)
12.3	50	0.0200
9.2	585	0.0450
21.5	635	Total
		0.07
		(ft/sec)
		(cfs)

Sheet Flow, TRAVEL PATH A TO B
 Woods: Light underbrush, n= 0.400 P2= 3.20"
 Shallow Concentrated Flow, TRAVEL PATH B TO C
 Woodland, Ks= 5.0 fps

Subcatchment 1E: DA 1E



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Summary for Subcatchment 2E: DA 2E

Runoff = 42.43 cfs @ 12:23 hrs, Volume= 3,860 af, Depth> 3.55"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 Type III 24-hr 100YR Rainfall=8.84"

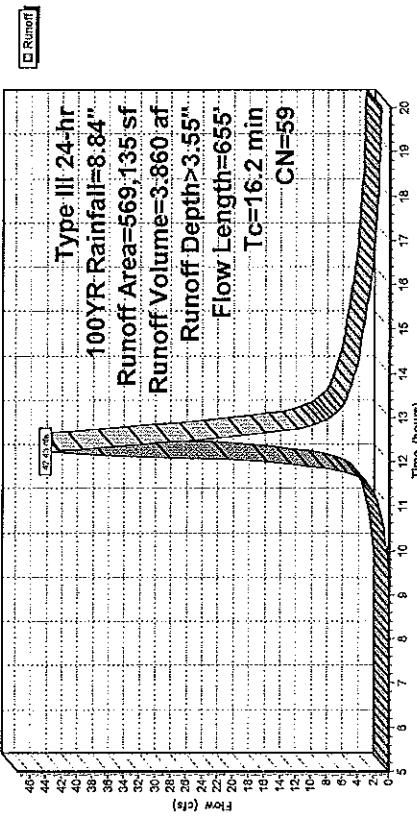
Area (sf)	CN	Description
537,108	58	Woods/grass comb., Good, HSG B
32,026	82	Dirt roads, HSG B
569,135	59	Weighted Average

Tc (min) Length (feet) Slope (ft/ft) Velocity (ft/sec) Capacity (cfs) Description

9.9	30	0.0500	0.05	Sheet Flow, TRAVEL PATH A TO B
6.3	625	0.1100	1.66	Woods: Dense underbrush n= 0.800 P2= 3.20" Shallow Concentrated Flow, TRAVEL PATH B TO C
16.2	655 Total			Woodland Kv= 5.0 fps

Subcatchment 2E: DA 2E

Hydrograph



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Type III 24-hr 100YR Rainfall=8.84"
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Summary for Subcatchment 3E: DA 3E

Runoff = 57.70 cfs @ 12:48 hrs, Volume= 7,051 af, Depth> 3.64"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 Type III 24-hr 100YR Rainfall=8.84"

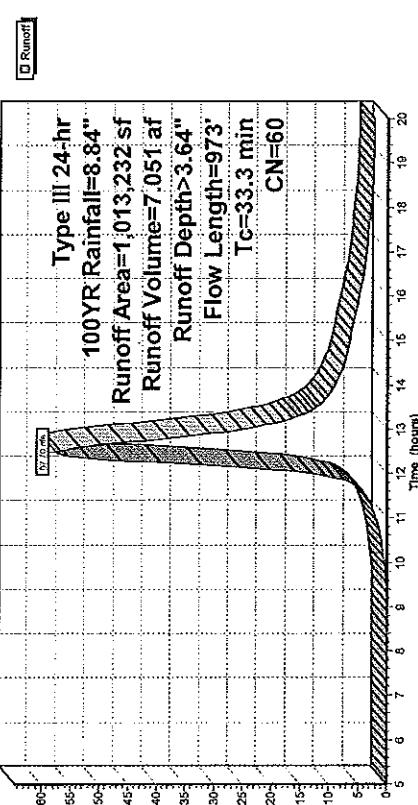
Area (sf)	CN	Description
692,936	58	Woods/grass comb., Good, HSG B
34,219	98	Paved parking & roofs
286,077	61	>75% Grass cover, Good, HSG B

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
21.5	50	0.0200	0.04	Sheet Flow, TRAVEL PATH A TO B	
10.5	777	0.0610	1.23	Woods: Dense underbrush n= 0.800 P2= 3.20" Shallow Concentrated Flow, TRAVEL PATH B TO C	
1.3	146	0.0360	1.90	Woodland Kv= 5.0 fops Shallow Concentrated Flow, TRAVEL PATH C TO D	

33.3 973 Total

Subcatchment 3E: DA 3E

Hydrograph



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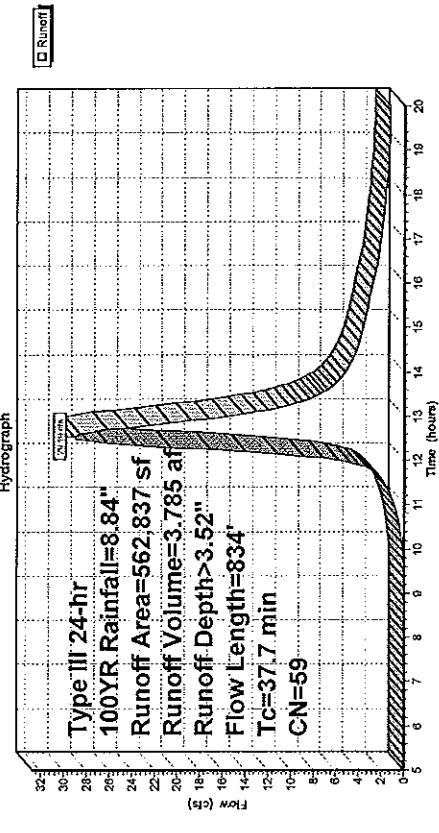
Summary for Subcatchment 4E: DA 4E

Runoff = 29.19 cfs @ 12.54 hrs, Volume= 3,785 af, Depth> 3.52"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100YR Rainfall=8.84"

Area (sf)	CN	Description			
532,837	58	Woods/grass comb., Good, HSG B			
12,000	98	Water Surface, HSG B			
18,000	61	>75% Grass cover, Good, HSG B			
562,837	59	Weighted Average 97.87% Pervious Area 2.13% Impervious Area			
550,837					
12,000					
Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
28.3	50	0.0100	0.03	Sheet Flow, TRAVEL PATH A TO B Woods: Dense underbrush n= 0.800 P2= 3.20" Shallow Concentrated Flow, TRAVEL PATH B TO C Woodland: Ki= 5.0 fps	
9.4	784	0.0770	1.39		
37.7	834	Total			

Subcatchment 4E: DA 4E



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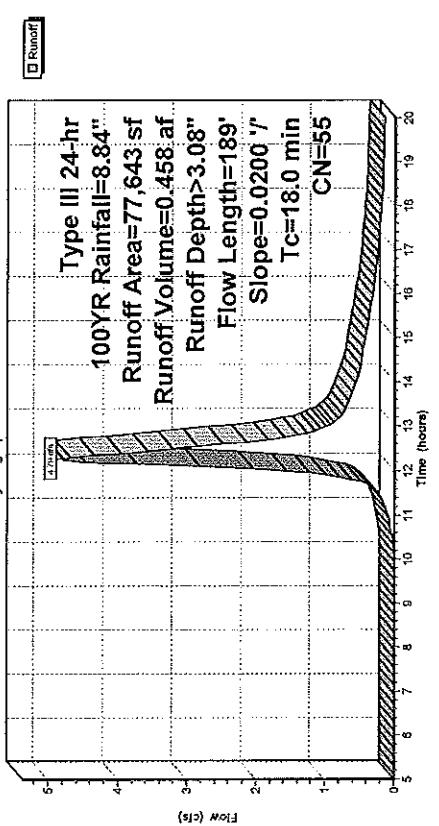
Type III 24-hr 100YR Rainfall=8.84"
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Summary for Subcatchment 5E: DA 5E

Runoff = 4.79 cfs @ 12.26 hrs, Volume= 0,458 af, Depth> 3.08"
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100YR Rainfall=8.84"

Area (sf)	CN	Description			
77,643	55	Woods, Good, HSG B			
77,643		100.00% Pervious Area			
Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.3	30	0.0200	0.04	Sheet Flow, TRAVEL PATH A TO B Woods: Dense underbrush n= 0.800 P2= 3.20" Shallow Concentrated Flow, TRAVEL PATH Woodland: Ki= 5.0 fps	
3.7	159	0.0200	0.71		
18.0	189	Total			

Subcatchment 5E: DA 5E



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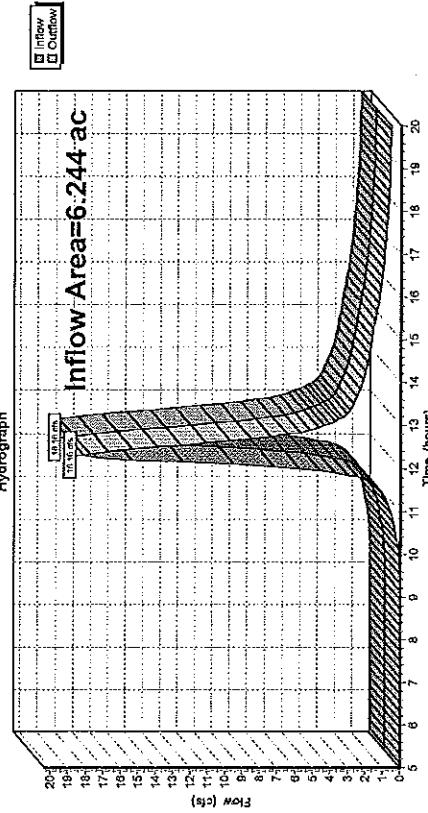
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Type III 24-hr 100YR Rainfall=8.84"
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Page 50

Inflow Area = 6.244 ac, 0.00% Impervious, Inflow Depth > 3.54" for 100YR event
Inflow = 18.16 cfs @ 12.31 hrs, Volume= 1.841 af
Outflow = 18.16 cfs @ 12.31 hrs, Volume= 1.841 af, Attenu= 0%, Lag= 0.0 min
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Reach IP-1: VERNAL POOL

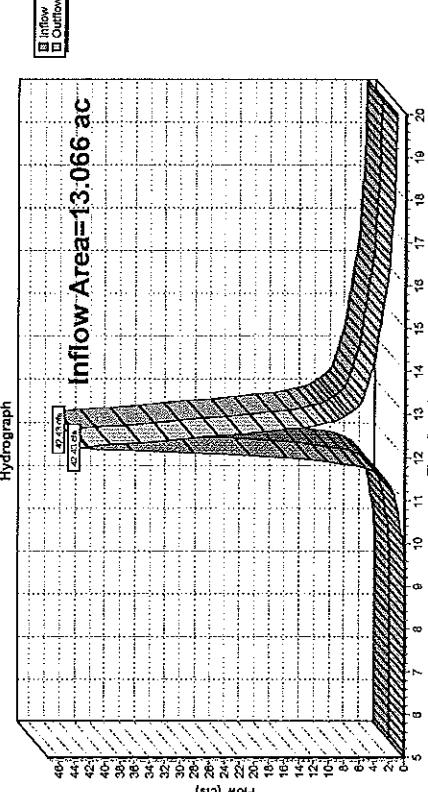
Reach IP-1: VERNAL POOL



Inflow Area = 13.066 ac, 0.00% Impervious, Inflow Depth > 3.55" for 100YR event
Inflow = 42.43 cfs @ 12.23 hrs, Volume= 3.860 af
Outflow = 42.43 cfs @ 12.23 hrs, Volume= 3.860 af, Attenu= 0%, Lag= 0.0 min
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Summary for Reach IP-2: PROP. LINE

Reach IP-2: PROP. LINE



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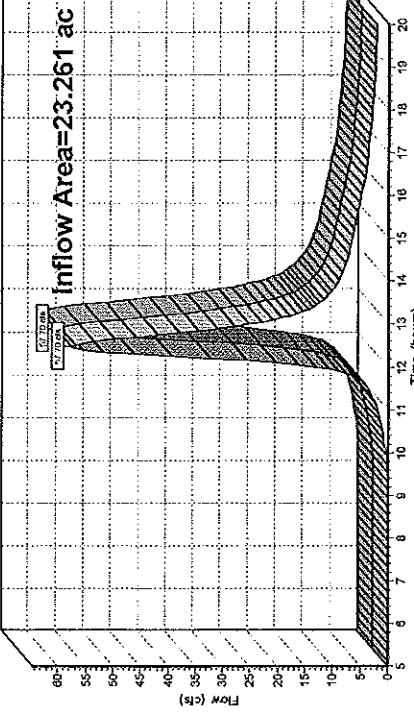
Type III 24-hr 100YR Rainfall=8.84"
Printed 9/1/2017
Page 52.

Summary for Reach IP-3: WETLANDS

Inflow Area = 23.261 ac, 3.38% Impervious, Inflow Depth > 3.64" for 100YR event
Inflow = 57.70 cfs @ 12.48 hrs, Volume= 7.051 af
Outflow = 57.70 cfs @ 12.48 hrs, Volume= 7.051 af, Atten= 0%, Lag= 0.0 min
Routing by StoR-Ind+Trans method, Time Span= 5:00-20:00 hrs, dt= 0.05 hrs

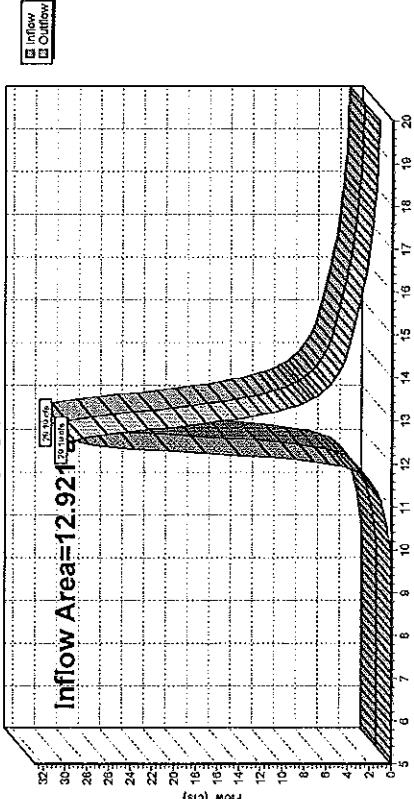
Reach IP-3: WETLANDS

Hydrograph



Reach IP-4: PROPS. LINE

Hydrograph



Summary for Reach IP-4: PROPS. LINE

Inflow Area = 12.921 ac, 2.13% Impervious, Inflow Depth > 3.52" for 100YR event
Inflow = 29.19 cfs @ 12.54 hrs, Volume= 3.785 af
Outflow = 29.19 cfs @ 12.54 hrs, Volume= 3.785 af, Atten= 0%, Lag= 0.0 min
Routing by StoR-Ind+Trans method, Time Span= 5:00-20:00 hrs, dt= 0.05 hrs

PRE DEVELOPMENT

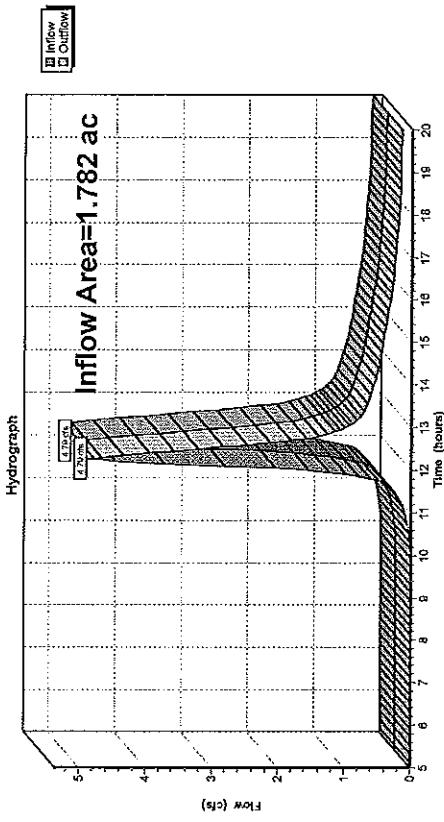
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Type III 24-hr 100YR Rainfall=8.84"
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Summary for Reach IP-5: property line

Inflow Area = 1.782 ac, 0.00% Impervious, Inflow Depth > 3.08" for 100YR event
Inflow = 4.79 cfs @ 12.26 hrs, Volume= 0.488 af
Outflow = 4.79 cfs @ 12.26 hrs, Volume= 0.488 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind-Trans method, Time Span= 5:00-20:00 hrs, dt= 0.05 hrs

Reach IP-5: property line

DRAINAGE ANALYSIS

HydroCAD Calculations – Proposed Conditions

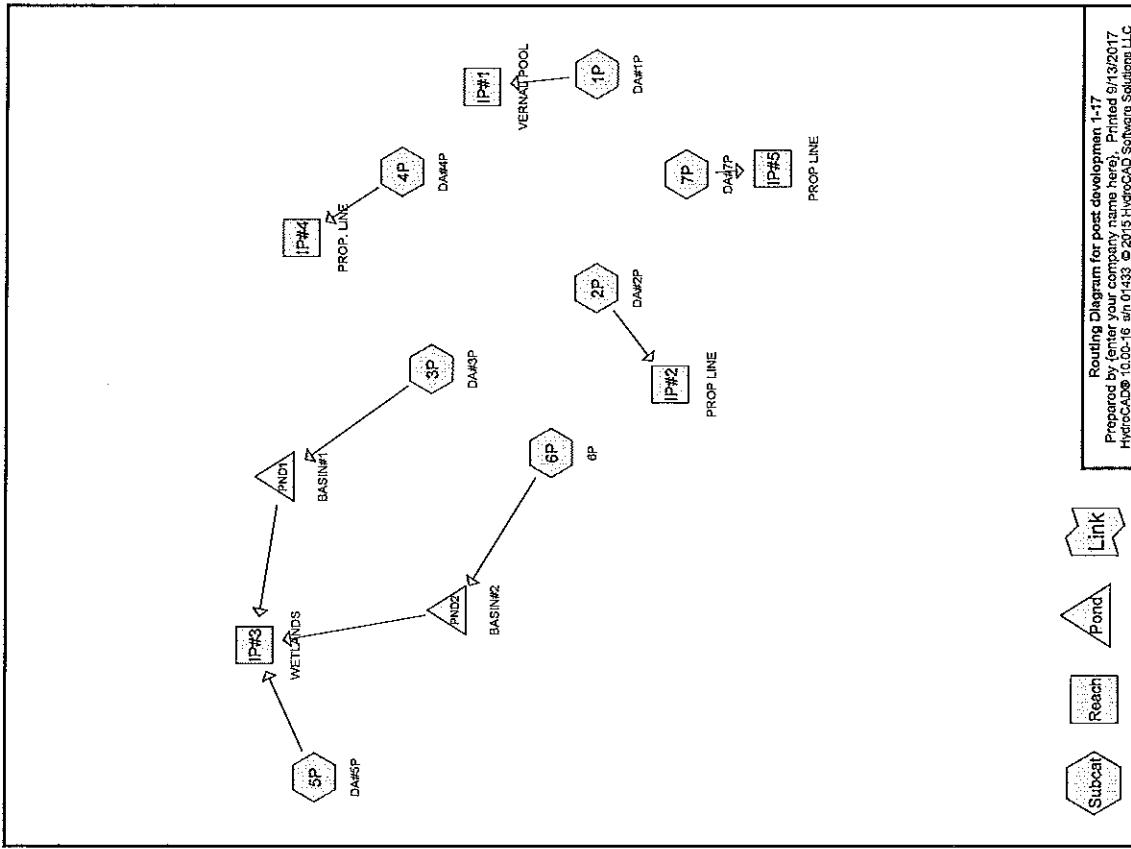
post development 1-17

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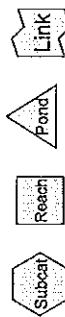
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Page 2

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-number(s))
18.328	61	>75% Grass cover, Good, HSG B (1P, 2P, 3P, 4P, 5P, 6P)
4.462	98	Paved parking & roofs (1P, 2P, 3P, 4P)
0.786	98	Paved parking, HSG A (5P)
1.125	98	Paved parking, HSG B (6P)
24.036	55	Woods, Good, HSG B (1P, 3P, 5P, 6P, 7P)
8.534	58	Woods/grass comb., Good, HSG B (2P, 4P)



Routing Diagram for post development 1-17
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Page 3

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.786	HSG A	5P
52.023	HSG B	1P, 2P, 3P, 4P, 5P, 6P, 7P
0.000	HSG C	
0.000	HSG D	
4.462	Other	1P, 2P, 3P, 4P

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Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Watt (inches)	Height (inches)	Inside-Fill (inches)
1	1P	0.00	0.00	100.0	0.0150	0.012	12.0	0.0	0.0
2	6P	0.00	0.00	283.0	0.0500	0.011	12.0	0.0	0.0

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Type III 24-hr 2YR Rainfall=3.28"
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 Page 5

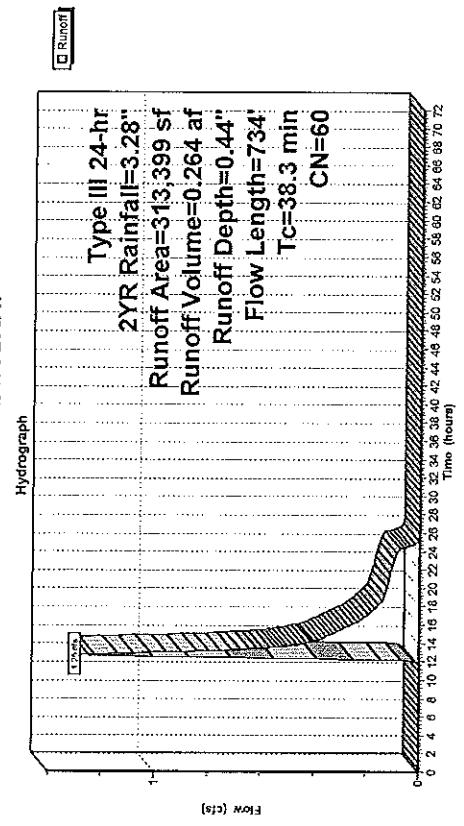
Summary for Subcatchment 1P: DA#1P

Runoff	=	1.25 cfs @ 12.69 hrs, Volume= 0.264 af, Depth= 0.44"			
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs					
Type III 24-hr 2YR Rainfall=3.28"					
Area (sf)	CN	Description			
24,004	98	Paved parking & roofs			
80,175	61	>75% Grass cover, Good, HSG B			
209,220	55	Woods, Good, HSG B			
313,399	60	Weighted Average			
289,395		92.34% Pervious Area			
24,004		7.66% Impervious Area			
Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
28.3	50	0.0100	0.03		Sheet Flow, TRAVEL PATH A TO B
6.6	375	0.0350	0.95		Woods: Dense underbrush n = 0.800 P2= 3.20"
0.3	100	0.0150	6.02	4.73	Shallow Concentrated Flow, TRAVEL PATH B TO C Woodland Kv= 5.0 fps Pipe Channel, TRAVEL PATH D TO E 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012 Concrete pipe, finished
0.8	89	0.0150	1.84		Shallow Concentrated Flow, TRAVEL PATH E TO F Grassed Waterway Kv= 15.0 fps
2.3	120	0.0300	0.87		Shallow Concentrated Flow, TRAVEL PATH F TO G Woodland Kv= 5.0 fps
38.3	734	Total			

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Subcatchment 1P: DA#1P



Runoff

Type III 24-hr 2YR Rainfall=3.28"
 Runoff Area=313,399 sf
 Runoff Volume=0.264 af
 Runoff Depth=0.44"
 Flow Length=734'
 Tc=38.3 min
 CN=60

Hydrograph

Type III 24-hr 2YR Rainfall=3.28"

Runoff Area=313,399 sf
 Runoff Volume=0.264 af
 Runoff Depth=0.44"

Flow Length=734'
 Tc=38.3 min
 CN=60

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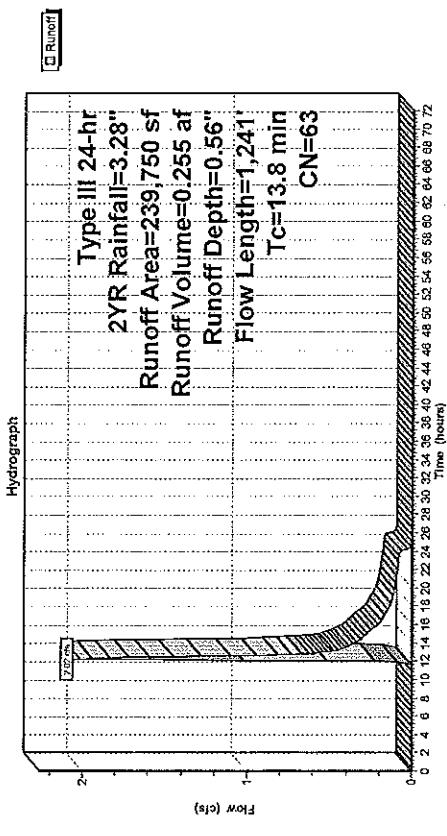
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Subcatchment 2P: DA#2P

Runoff = 2.02 cfs @ 12.25 hrs, Volume= 0.255 af. Depth= 0.56"
 Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
 Type III/24-hr 2YR Rainfall=3.28"

Tc	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.4	50	0.0100	0.11	Sheet Flow, TRAVEL PATH A TO B	
5.0	1,081	0.0500	3.60	Grass; Short r=0.150 P2=3.20" Shallow Concentrated Flow, TRAVEL PATH B TO C	
1.4	110	0.0720	1.34	Unpaved Kv=16.1 fps Shallow Concentrated Flow, TRAVEL PATH C TO D Viceland Kv=5.0 fips	
13.8	1,241	Total			

Subcatchment 2P: DA#2P

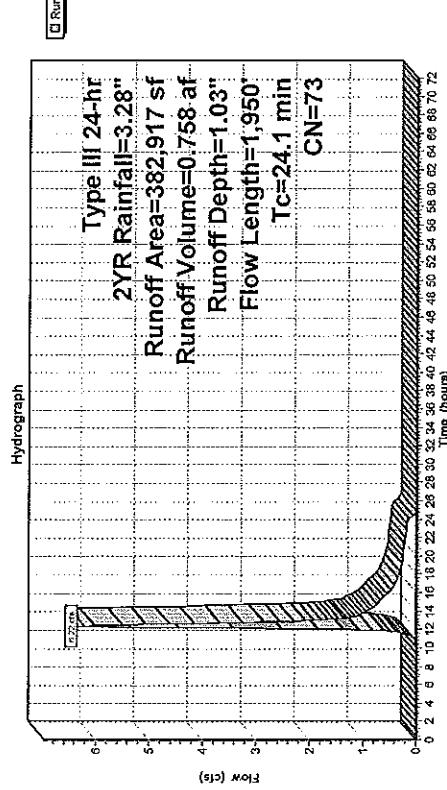


Summary for Subcatchment 3P: DA#3P

Runoff = 6.22 cfs @ 12.37 hrs, Volume= 0.758 af, Depth= 1.03"
 Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
 Type III/24-hr 2YR Rainfall=3.28"

Area (sf)	CN	Description	Area (sf)	CN	Description
23,199	98	Paved parking & roofs	131,794	98	Paved parking & roofs
127,802	61	>75% Grass cover, Good, HSG B	182,960	61	>75% Grass cover, Good, HSG B
88,749	58	Woods/grass comb., Good, HSG B	68,163	55	Woods, Good, HSG B
239,750	63	Weighted Average	382,917	73	Weighted Average
2,16,551		90.32% PerVIOUS Area	251,123		65.58% PerVIOUS Area
23,199		9.68% Impervious Area	131,794		34.42% Impervious Area
Tc	Length (min)	Slope (feet)	Velocity (ft/sec)	Capacity (cfs)	Description
16.3	50	0.0400	0.05	Sheet Flow, TRAVEL PATH A TO B	
0.8	200	0.0600	3.94	Woods: Dense underbrush n=0.800 P2=3.20" Shallow Concentrated Flow, TRAVEL PATH B TO C	
7.0	1,700	0.0400	4.06	Unpaved Kv=16.1 fips Shallow Concentrated Flow, TRAVEL PATH C TO D	
24.1	1,950	Total			Paved Kv=20.3 fips

Summary for Subcatchment 3P: DA#3P



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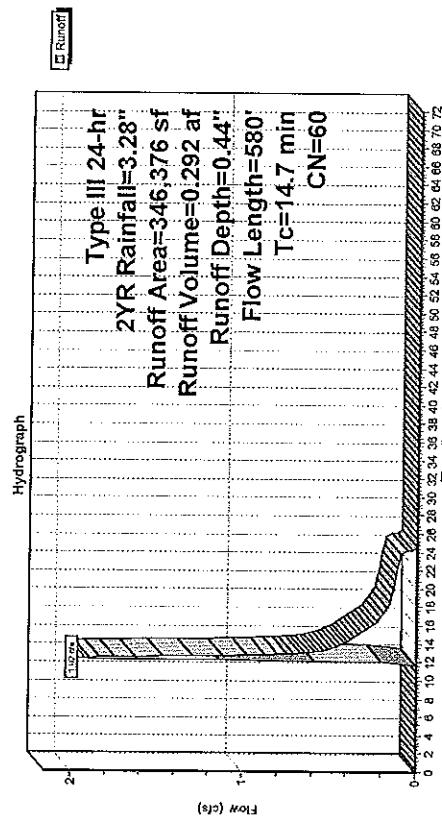
Summary for Subcatchment 4P: DA#4P

$$\text{Runoff} = 1.92 \text{ cfs} @ 12.31 \text{ hrs, Volume=} 0.292 \text{ af, Depth=} 0.44"$$

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2YR Rainfall=3.28"

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.1	50	0.0250	0.16	Sheet Flow, TRAVEL PATH A TO B Grass: Short n= 0.150 P2= 3.20" Shallow Concentrated Flow, TRAVEL PATH B TO C Unpaved Kv= 16.1 fps Shallow Concentrated Flow, TRAVEL PATH C TO D Woodland Kv= 5.0 fps	
0.3	80	0.0750	4.41		
9.3	450	0.0260	0.81		
14.7	580	Total			

Subcatchment 4P: DA#4P



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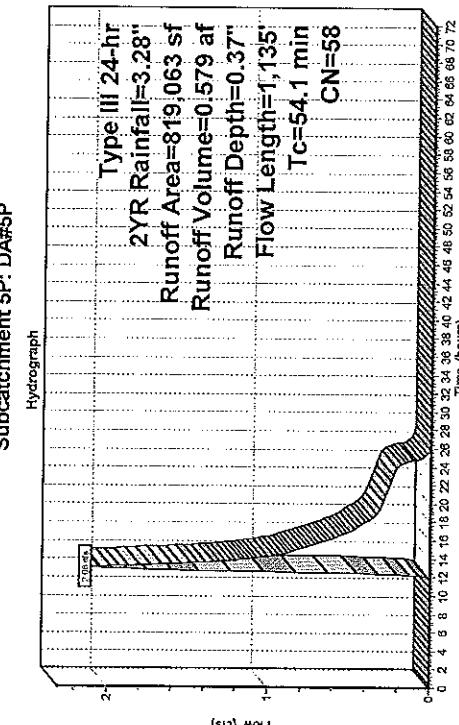
Summary for Subcatchment 5P: DA#5P

$$\text{Runoff} = 2.08 \text{ cfs} @ 12.97 \text{ hrs, Volume=} 0.579 \text{ af, Depth=} 0.37"$$

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2YR Rainfall=3.28"

Area (sf)	CN	Description
15,358	98	Paved parking & roofs
61	>75% Grass cover, Good HSG B	
48,009	61	75% Grass cover, Good, HSG B
283,009	58	Wood/grass comb.. Good, HSG B
346,376	60	Weighted Average
331,018	95.57%	Pervious Area
15,358	4.43%	Impervious Area
54.1	1,135	Total

Subcatchment 5P: DA#5P



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Type III 24-hr 2YR Rainfall=3.28"

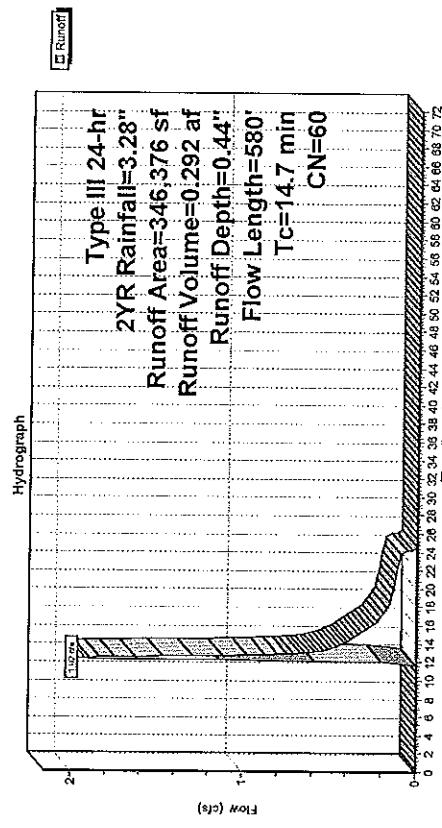
Summary for Subcatchment 5P: DA#5P

$$\text{Runoff} = 0.579 \text{ af, Depth=} 0.37"$$

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2YR Rainfall=3.28"

Area (sf)	CN	Description
34,219	98	Paved parking, HSG A
153,139	61	>75% Grass cover, Good, HSG B
631,705	55	Woods, Good, HSG B
784,844	58	Weighted Average
34,219	95.82%	Pervious Area
4.18%		Impervious Area
54.1	1,135	Total

Subcatchment 5P: DA#5P



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Summary for Subcatchment 6P: 6P

Runoff = 2.33 cfs @ 12.66 hrs, Volume= 0.427 af, Depth= 0.60"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
 Type III/24-hr 2YR Rainfall=3.28"

Area (sf)	CN	Description
49,012	98	Paved parking, HSG B
206,262	61	>75% Grass cover, Good, HSG B
118,543	55	Woods, Good, HSG B
373,817	64	Weighted Average
324,805	86	86.89% Pervious Area
49,012	13	13.11% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
18.3	50	0.0300	0.05	Sheet Flow, TRAVEL PATH A TO B	
1.6	135	0.0800	1.41	V-Woods: Dense underbrush n= 0.800 P2= 3.20"	
				Shallow Concentrated Flow, TRAVEL PATH B TO C	
19.4	555	0.0330	0.48	Woodland Kv= 5.0 fps	
				TrapVee Rect Channel Flow, TRAVEL C TO D	
0.4	283	0.0500	11.99	Bot,W=2.00' D=1.00' Z=2.0' Top,W=6.00' n= 0.410 Sheet flow over Bermuda Grass	
				Pipe Channel, TRAVEL PATH D TO E	
				12.0" Round Area= 0.8 ft Perim= 3.1' r= 0.25' n= 0.011 Concrete pipe, finished	
39.7	1,023	Total			

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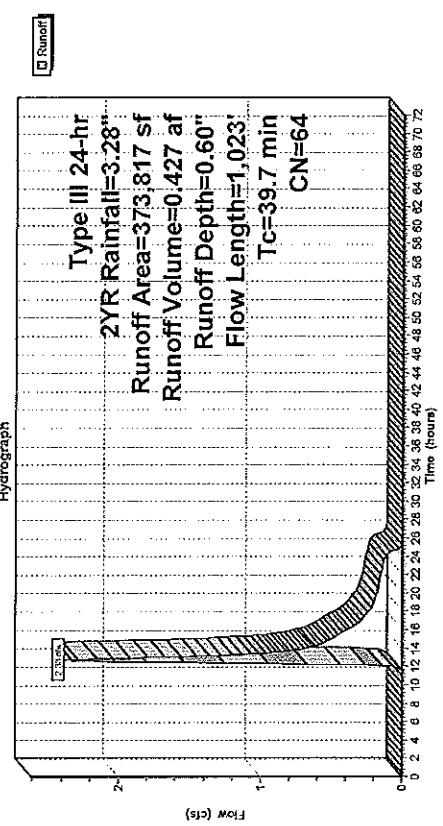
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Subcatchment 6P: 6P

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Summary for Subcatchment 7P: DA#7P

Runoff = 0.05 cfs @ 12:30 hrs, Volume= 0.010 af, Depth= 0.27"

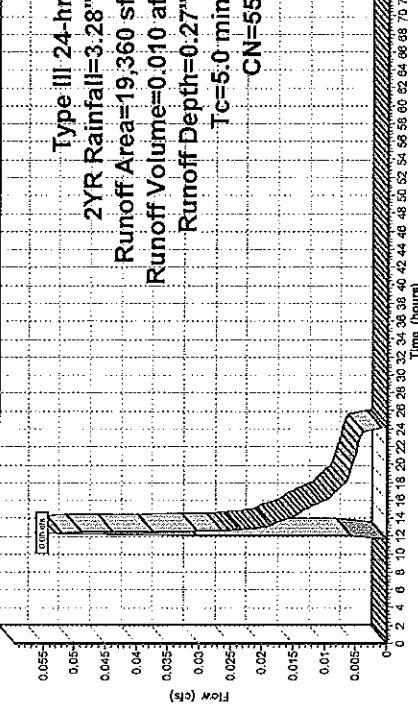
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2YR Rainfall=3.28"

Area (sf)	CN	Description
19,360	55	Woods, Good, HSG B

Tc Length Slope Capacity Description
(min) (feet) (ft/ft) (cfs)
5.0 Direct Entry, TRAVEL TIME

Subcatchment 7P: DA#7P

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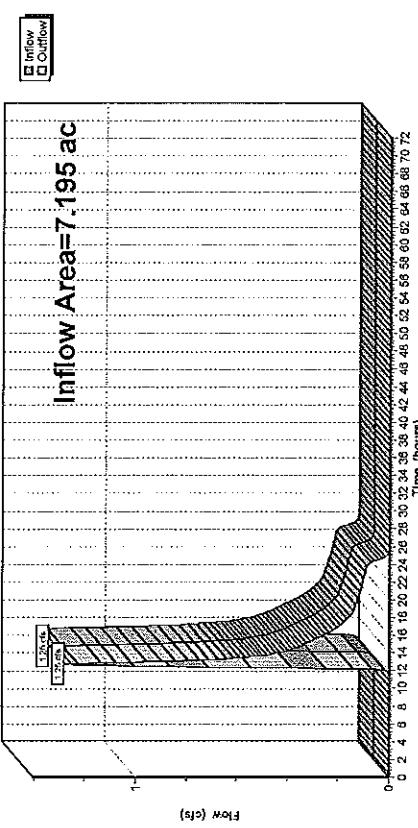
Type III 24-hr 2YR Rainfall=3.28"
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Summary for Reach IP#: VERNAL POOL

Inflow Area = 7.195 ac, 7.66% Impervious, Inflow Depth = 0.44" for 2YR event
Inflow = 1.25 cfs @ 12.69 hrs, Volume= 0.264 af
Outflow = 1.25 cfs @ 12.69 hrs, Volume= 0.264 af, Attenu= 0%, Lag= 0.0 min
Routing by Star-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Reach IP#1: VERNAL POOL

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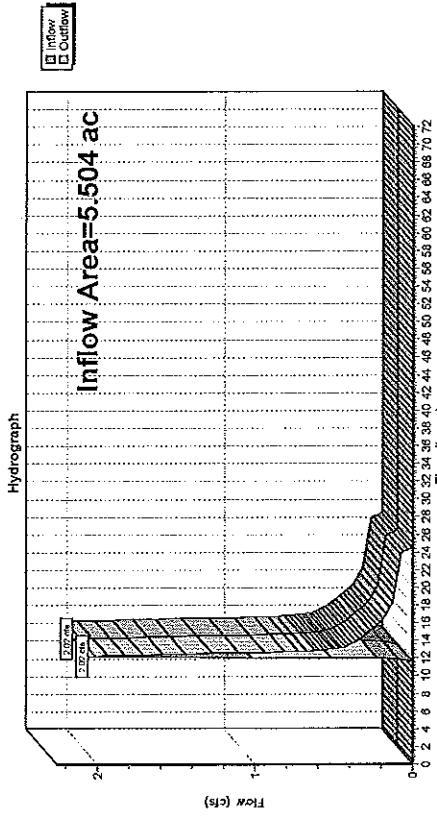
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Summary for Reach IP#2: PROP LINE

Inflow Area = 5.504 ac, 9.68% Impervious, Inflow Depth = 0.56" for 2YR event
Inflow = 2.02 cfs @ 12.25 hrs, Volume= 0.255 af
Outflow = 2.02 cfs @ 12.25 hrs, Volume= 0.255 af, Atten= 0%, Lag= 0.0 min

Routing by Sto-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Reach IP#2: PROP LINE



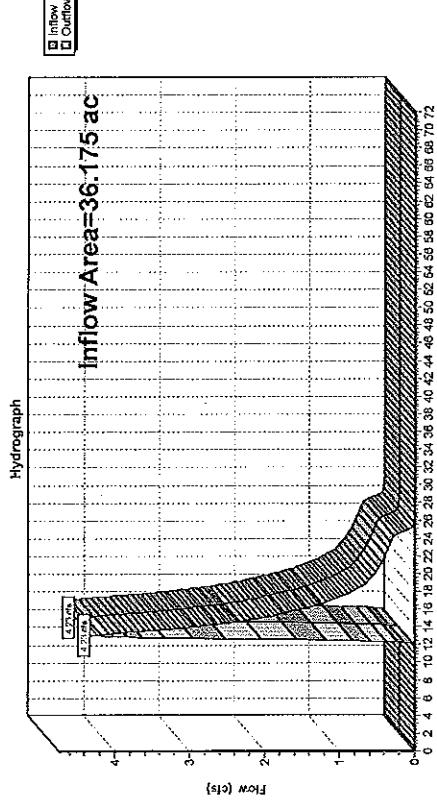
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66 68 70 72
Time (hours)

Summary for Reach IP#3: WETLANDS

Inflow Area = 36.175 ac, 13.65% Impervious, Inflow Depth = 0.41" for 2YR event
Inflow = 4.23 cfs @ 13.06 hrs, Volume= 1.243 af
Outflow = 4.23 cfs @ 13.06 hrs, Volume= 1.243 af, Atten= 0%, Lag= 0.0 min

Routing by Sto-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Reach IP#3: WETLANDS



0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66 68 70 72
Time (hours)

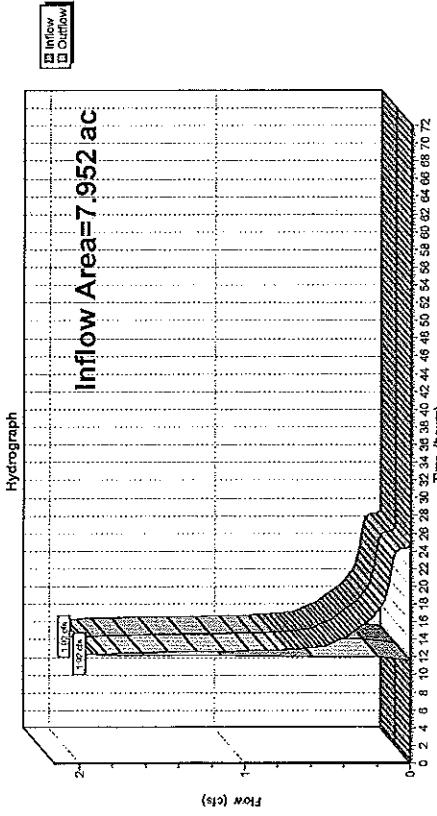
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Summary for Reach IP#4: PROP. LINE

Inflow Area = 7.952 ac, 4.43% Impervious, Inflow Depth = 0.44" for 2YR event
 Inflow = 1.92 cfs @ 12.31 hrs, Volume= 0.292 af
 Outflow = 1.92 cfs @ 12.31 hrs, Volume= 0.292 af, Atten= 0%, Lag= 0.0 min
 Routing by Sto-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

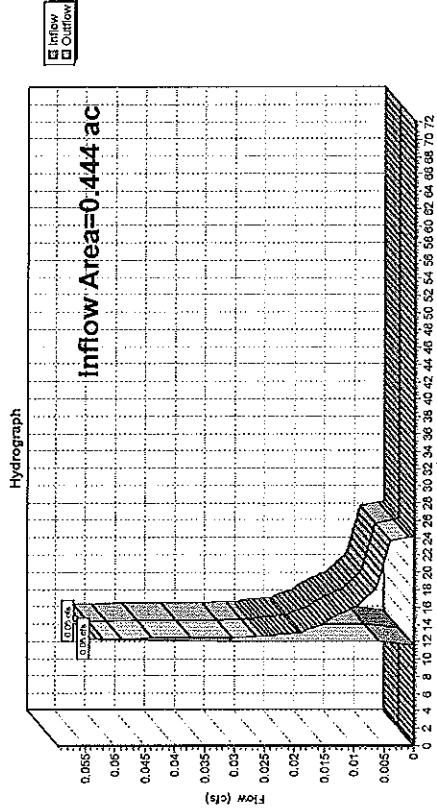
Reach IP#4: PROP. LINE



Summary for Reach IP#5: PROP LINE

Inflow Area = 0.444 ac, 0.00% Impervious, Inflow Depth = 0.27" for 2YR event
 Inflow = 0.05 cfs @ 12.30 hrs, Volume= 0.010 af
 Outflow = 0.05 cfs @ 12.30 hrs, Volume= 0.010 af, Atten= 0%, Lag= 0.0 min
 Routing by Sto-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Reach IP#5: PROP LINE



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Summary for Pond PND1: BASIN#1

Inflow Area = 8.791 ac, 34.42% Impervious, Inflow Depth = 1.03" for 2YR event
 Inflow = 6.22 cfs @ 12.37 hrs, Volume= 0.738 af
 Outflow = 1.32 cfs @ 13.29 hrs, Volume= 0.735 af, Attenu= 79%, Lag= 55.6 min
 Discarded = 0.22 cfs @ 13.29 hrs, Volume= 0.413 af
 Primary = 1.10 cfs @ 13.29 hrs, Volume= 0.345 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
 Peak Elev= 375.66' @ 13.29 hrs Surf.Area= 9.245 sf Storage= 13,641 cf

Plug-Flow detention time= 328.9 min calculated for 0.758 af (100% of inflow)
 Center-of-Mass det. time= 328.5 min (1.209,1 - 380.6)

Volume	Invert	Avail.Storage	Storage Description	Custom Stage Data (Prismatic) Listed below (Recalc)
#1	374.00'	82,639 cf		

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
374.00	7,184	0	0
376.00	9,666	16,850	16,850
378.00	12,357	22,023	38,873
380.00	15,306	27,663	66,536
381.00	16,900	16,103	82,639

Device Routing Invert Outlet Devices

#1	Discarded	374.00'	1.020 Inflr Exfiltration over Surface area
#2	Primary	375.00'	6.0" Vert. Orifice/Grate C= 0.600
#3	Primary	375.25'	8.0" Vert. Orifice/Grate C= 0.600
#4	Primary	378.25'	12.0" Vert. Orifice/Grate C= 0.600

Discarded OutFlow Max=0.22 cfs @ 13.29 hrs HW=375.66' (Free Discharge)

OutFlow Max=1.10 cfs @ 13.29 hrs HW=375.66' (Free Discharge)

Orifice/Grate (Orifice Controls 0.61 cfs @ 3.09 fps)

Orifice/Grate (Orifice Controls 0.49 cfs @ 2.18 fps)

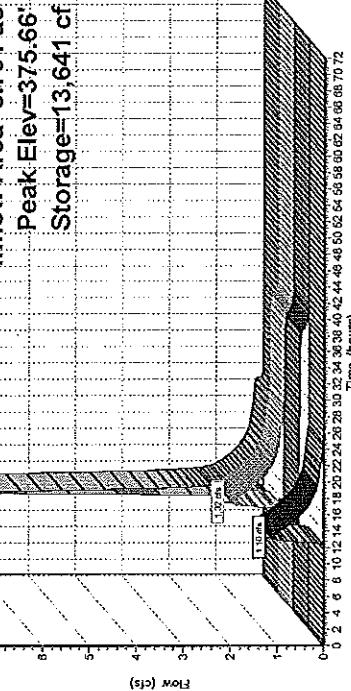
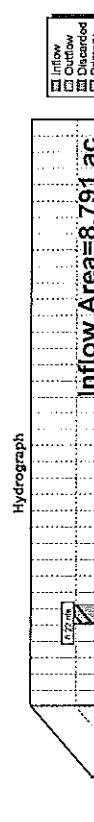
Orifice/Grate (Controls 0.00 cfs)

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Pond PND1: BASIN#1



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Summary for Pond PND2: BASIN#2

Inflow Area = 8.582 ac, 13.11% Impervious, Inflow Depth = 0.60" for 2YR event
 Inflow = 2.33 cfs @ 12.66 hrs, Volume= 0.427 af
 Outflow = 1.29 cfs @ 13.19 hrs, Volume= 0.427 af, Attenu= 45%, Lag= 31.5 min
 Discarded = 0.11 cfs @ 13.19 hrs, Volume= 0.109 af
 Primary = 1.18 cfs @ 13.19 hrs, Volume= 0.318 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
 Peak Elev= 370.81' @ 13.19 hrs Surf.Area= 4,825 sf Storage= 3,479 cf
 Plug-Flow detention time= 48.3 min calculated for 0.427 af (100% of inflow)
 Center-of-Mass det. time= 48.0 min (976.6 - 928.5)

Volume	Invert	Avail.Storage	Storage Description	Custom Stage Data (P-Prismatic) Listed below (Recalc)
#1	370.00'	35,650 cf		

Elevation	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
370.00	3,750	0	0
372.00	6,400	10,150	10,150
374.00	9,300	15,700	25,850
375.00	10,300	9,800	35,650

Device	Routing	Invert	Outlet Devices
#1	Discarded	370.00'	1,020 in/hr Exfiltration over Surface area
#2	Primary	370.00'	8.0" Vert. Orifice/Grate C= 0.600
#3	Primary	370.75'	10.0" Vert. Orifice/Grate C= 0.600
#4	Primary	372.85'	12.0" Vert. Orifice/Grate C= 0.600

Discarded OutFlow Max=0.11 cfs @ 13.19 hrs HW=370.81' (Free Discharge)

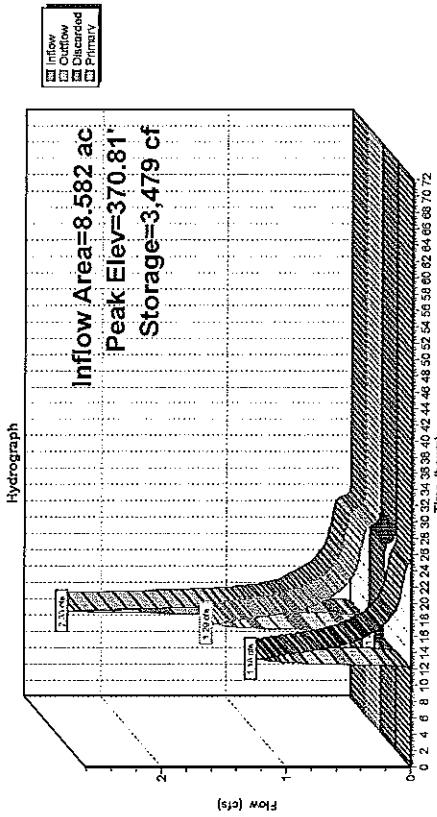
↓=1=Exfiltration (Exfiltration Controls 0.11 cfs)

↑=2=Orifice/Grate (Orifice Controls 1.16 cfs @ 3.33 tps)

→=3=Orifice/Grate (Orifice Controls 0.02 cfs @ 0.84 tps)

↔=4=Orifice/Grate (Controls 0.00 cfs)

Pond PND2: BASIN#2



Pond PND2: BASIN#2

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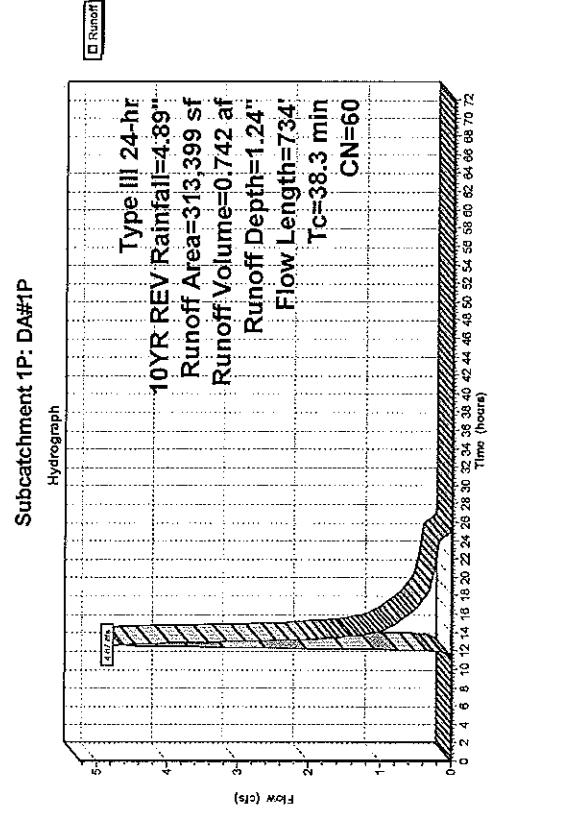
Type III 24-hr 10YR REV Rainfall=4.89"
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Summary for Subcatchment 1P: DA#1P

Runoff = 4.57 cfs @ 12.60 hrs, Volume= 0.742 af, Depth= 1.24"
 Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
 Type III 24-hr 10YR REV Rainfall=4.89"

Area (sf)	CN	Description
24,004	98	Paved parking & roofs
80,175	61	>75% Grass cover, Good, HSG B
209,220	56	Woods, Good, HSG B
289,399	60	Weighted Average
289,395	92.34%	Previous Area
24,004	7.66%	Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
28.3	50	0.0100	0.03	Sheet Flow, TRAVEL PATH A TO B	
6.6	375	0.0360	0.95	V Woods: Dense underbrush r= 0.800 P2= 3.20"	
0.3	100	0.0150	6.02	Shallow Concentrated Flow, TRAVEL PATH B TO C Woodland Kv= 5.0 fps	
0.8	89	0.0150	1.84	Pipe Channel, TRAVEL PATH D TO E 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n = 0.012 Concrete pipe, finished	
2.3	120	0.0300	0.87	Shallow Concentrated Flow, TRAVEL PATH E TO F Grassed Waterway Kv= 15.0 fps	
38.3	784	Total		Shallow Concentrated Flow, TRAVEL PATH F TO G Woodland Kv= 5.0 fps	



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Type III 24-hr 10YR REV Rainfall=4.89"
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Summary for Subcatchment 2P: DA#2P

$$\text{Runoff} = 6.64 \text{ cfs} @ 12.21 \text{ hrs, Volume=} 0.660 \text{ af, Depth=} 1.44"$$

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
 Type III 24-hr 10YR REV Rainfall=4.89"

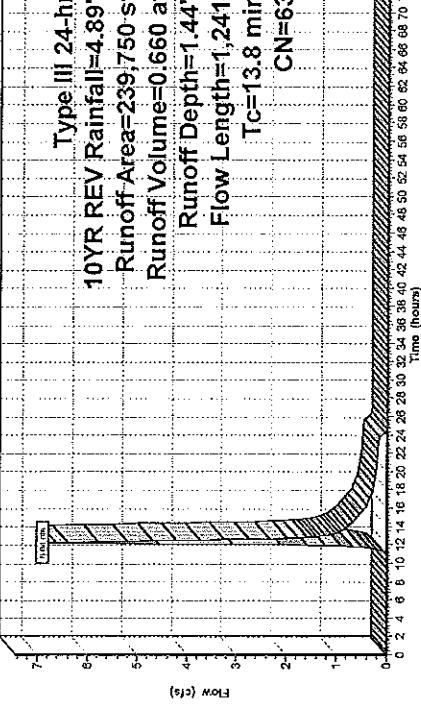
Area (sf)	CN	Description
23.199	98	Paved parking & roofs
127.802	61	>75% Grass cover, Good HSG B
88.749	58	Wood/grass comb., Good, HSG B
239.750	63	Weighted Average 90.32% PerVIOUS Area
216.551		9.68% Impervious Area
23.199		
13.8	1,241	Total

Tc Length Slope Velocity Capacity Description
 (min) (feet) (ft/ft) (ft/sec) (cfs)

7.4	50	0.0100	0.11	Sheet Flow, TRAVEL PATH A TO B Grass: Short n= 0.150 P2= 3.20"
5.0	1,081	0.0500	3.60	Shallow Concentrated Flow, TRAVEL PATH B TO C Unpaved Kv= 16.1 tps
1.4	110	0.0720	1.34	Shallow Concentrated Flow, TRAVEL PATH C TO D Woodland Kv= 5.0 tps

Subcatchment 2P: DA#2P

Hydrograph

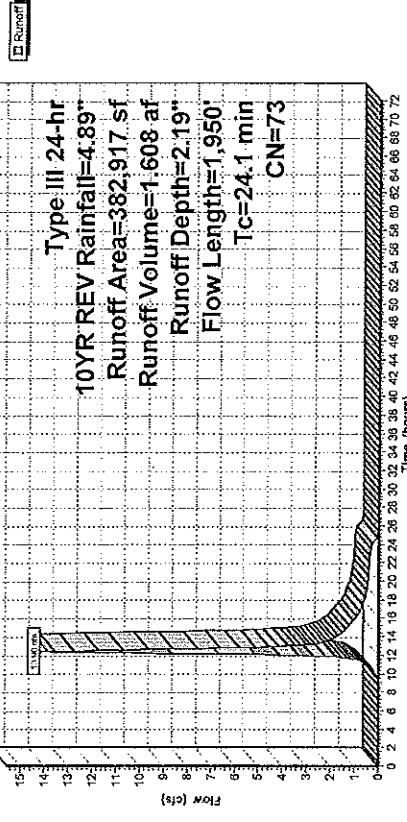


Runoff = 13.90 cfs @ 12.35 hrs, Volume= 1.608 af, Depth= 2.19"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
 Type III 24-hr 10YR REV Rainfall=4.89"

Summary for Subcatchment 3P: DA#3P

Hydrograph



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Summary for Subcatchment 3P: DA#3P

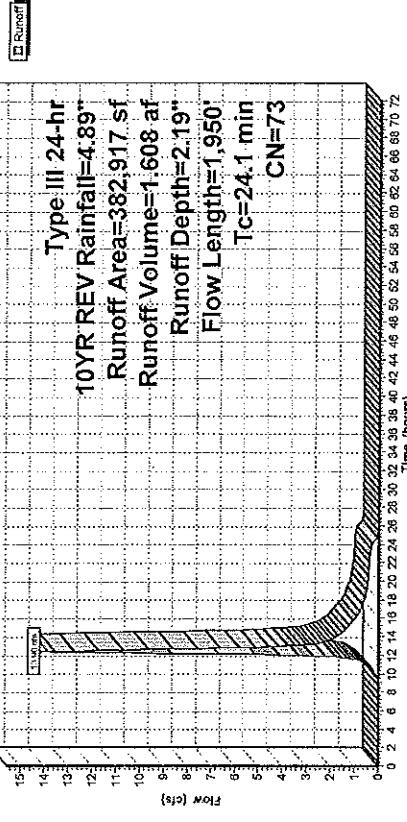
$$\text{Runoff} = 13.90 \text{ cfs} @ 12.35 \text{ hrs, Volume=} 1.608 \text{ af, Depth=} 2.19"$$

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
 Type III 24-hr 10YR REV Rainfall=4.89"

Area (sf)	CN	Description
131.794	98	Paved parking & roofs
182.960	61	>75% Grass cover, Good, HSG B
68.163	55	Woods, Good, HSG B
382.917	73	Weighted Average 65.58% PerVIOUS Area
131.794		34.42% Impervious Area
251.123		
13.8	1,950	Total

Subcatchment 3P: DA#3P

Hydrograph



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Summary for Subcatchment 4P: DA#4P

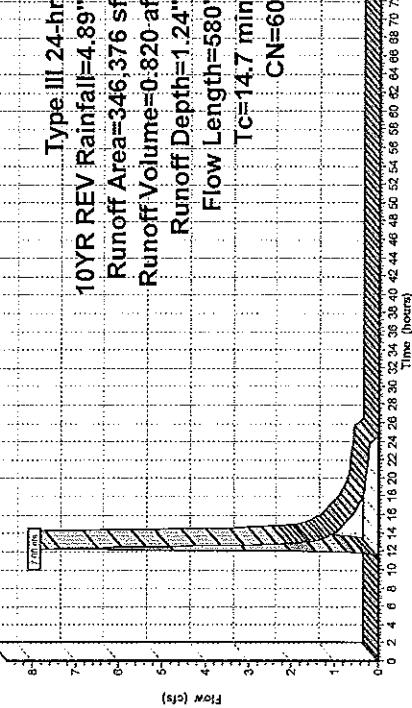
$$\text{Runoff} = 7.66 \text{ cfs} @ 12.23 \text{ hrs, Volume=} 0.820 \text{ af, Depth=} 1.24"$$

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
 Type III 24-hr 10YR REV Rainfall=4.89"

Area (sf)	CN	Description	Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15,358	98	Paved parking & roofs	5.1	50	0.0250	0.16	Sheet Flow, TRAVEL PATH A TO B	
48,009	61	>75% Grass cover, Good, HSG B	0.3	80	0.0750	4.41	Grass: Short n= 0.150 P2= 3.20"	
283,009	58	Woods/grass comb., Good, HSG B	9.3	450	0.0260	0.81	Shallow Concentrated Flow, TRAVEL PATH B TO C Up paved Kv= 16.1 fps Shallow Concentrated Flow, TRAVEL PATH C TO D Woodland Kv= 5.0 fps	
331,018	60	Weighted Average 95.57% PerVIOUS Area 4.43% IMPERVIOUS Area	14.7	580	Total			

Subcatchment 4P: DA#4P

Hydrograph



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Summary for Subcatchment 5P: DA#5P

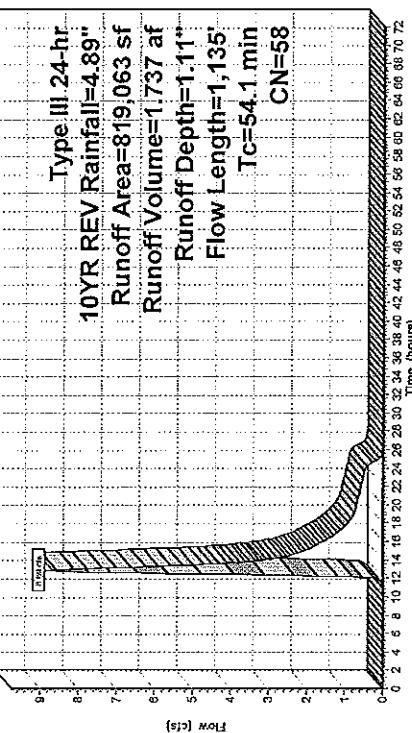
$$\text{Runoff} = 8.69 \text{ cfs} @ 12.84 \text{ hrs, Volume=} 1.737 \text{ af, Depth=} 1.11"$$

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
 Type III 24-hr 10YR REV Rainfall=4.89"

Area (sf)	CN	Description	Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
34,219	98	Paved parking, HSG A	21.5	50	0.0200	0.04	Sheet Flow, TRAVEL PATH A TO B	
153,139	61	>75% Grass cover, Good, HSG B	31.2	935	0.0100	0.50	Woods: Dense underbrush n= 0.800 P2= 3.20"	
631,705	55	Woods, Good, HSG B	1.4	150	0.0300	1.73	Shallow Concentrated Flow, TRAVEL PATH B TO C Woodland Kv= 5.0 fps	
819,063	58	Weighted Average					Shallow Concentrated Flow, TRAVEL PATH C TO D	
784,844		95.82% PerVIOUS Area					Nearly Bare & Untilled Kv= 10.0 fps	
34,219		4.18% IMPERVIOUS Area						
54.1	1,135	Total						

Subcatchment 5P: DA#5P

Hydrograph



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Summary for Subcatchment 6P: 6P

Runoff = 7.02 cfs @ 12.60 hrs, Volume= 1.030 af, Depth= 1.51"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10YR REV Rainfall=4.89"

Area (sf)	CN	Description
49,012	98	Paved parking, HSG B
296,262	61	>75% Grass cover, Good, HSG B
118,543	55	Woods, Good, HSG B
373,817	64	Weighted Average
324,805	86.89%	Pervious Area
49,012	13.11%	Impervious Area

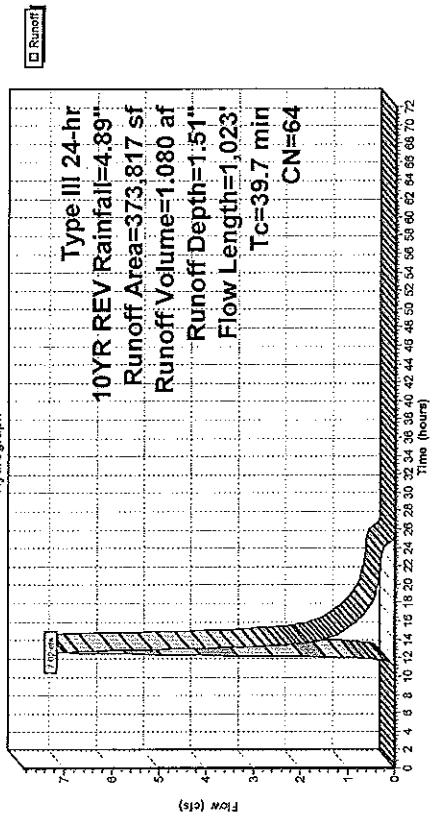
Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
18.3	50	0.0300	0.05	Sheet Flow, TRAVEL PATH A TO B	
1.6	135	0.0800	1.41	Vwoods: Dense underbrush n= 0.800 P2= 3.20° Shallow Concentrated Flow, TRAVEL PATH B TO C	
19.4	555	0.0330	0.48	Woodland Kv= 5.0 lps Trap/FreeRect Channel Flow, TRAVEL C TO D Bot.W=2.00' Z= 2.0' Top.W=6.0' n= 0.410 Sheer flow over Bermuda Grass	
0.4	283	0.0500	11.99	Pipe Channel, TRAVEL PATH D TO E 12.0" Round Area= 0.8 sf Penim= 3.1' r= 0.25' n= 0.011 Concrete pipe, finished	
39.7	1,023	Total			

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Subcatchment 6P: 6P

Hydrograph



Type III 24-hr 10YR REV Rainfall=4.89"

Runoff Area=373.817 sf

Runoff Volume=1.080 af

Runoff Depth=1.51"

Flow Length=1,023

Tc=39.7 min

CN=64

Time (hours)

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Summary for Subcatchment 7P: DA#7P

Runoff = 0.39 cfs @ 12.10 hrs, Volume= 0.034 af, Depth= 0.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10YR REV Rainfall=4.89"

Area (sf) CN Description

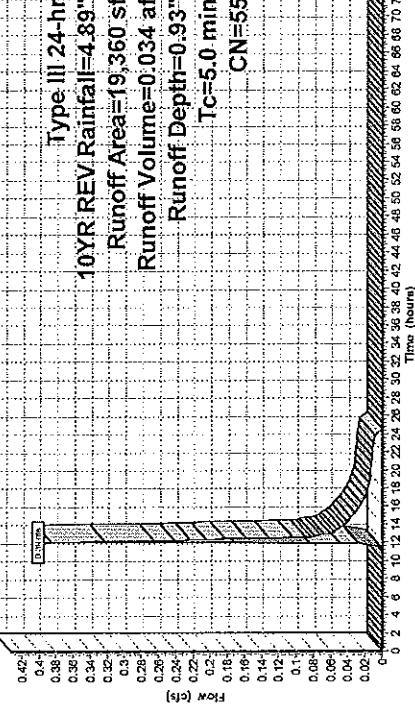
19,360	55	Woods, Good, HSG B
19,360		100.00% Previous Area

Tc (min) Length (feet) Slope (ft/ft) Velocity (ft/sec) Capacity (cfs) Description

5.0 Direct Entry, TRAVEL TIME

Subcatchment 7P: DA#7P

Hydrograph



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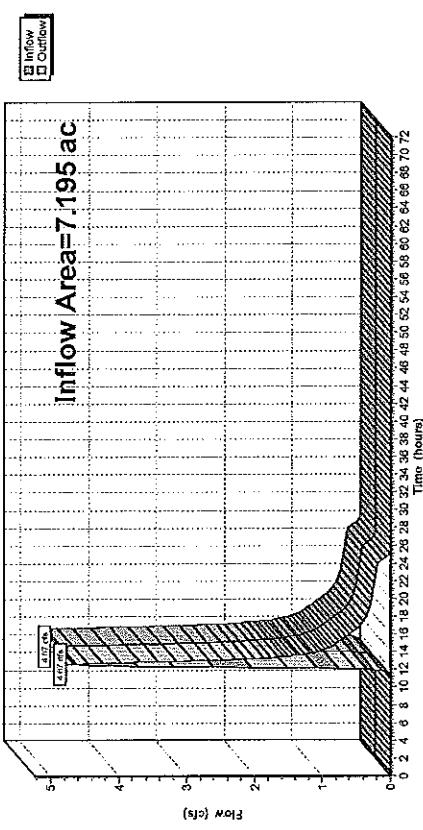
Summary for Reach IP#1: VERNAL POOL

Inflow Area = 7.195 ac, 7.66% Impervious, Inflow Depth = 1.24" for 10YR REV event
Inflow = 4.67 cfs @ 12.60 hrs, Volume= 0.742 af
Outflow = 4.67 cfs @ 12.60 hrs, Volume= 0.742 af, Attenu= 0%, Lag= 0.0 min

Routing by Stoer-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Reach IP#1: VERNAL POOL

Hydrograph



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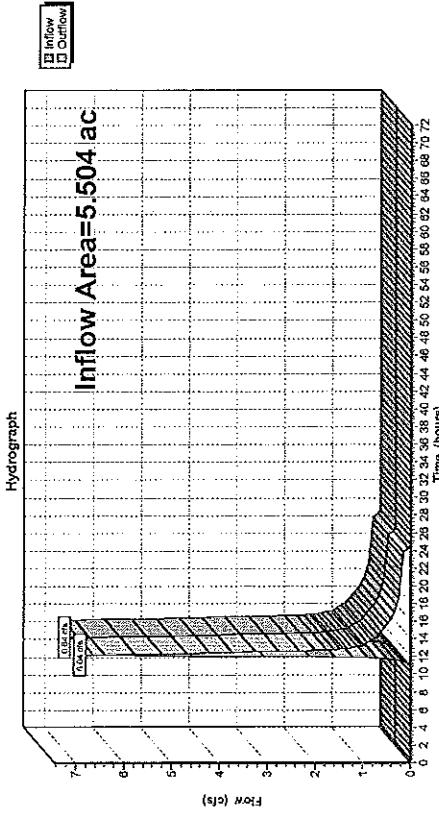
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Summary for Reach IP#2: PROP LINE

Inflow Area = 5.504 ac, 9.68% Impervious, Inflow Depth = 1.44" for 10YR REV event
Inflow = 6.64 cfs @ 12.21 hrs, Volume= 0.660 af
Outflow = 6.64 cfs @ 12.21 hrs, Volume= 0.660 af, Atten= 0%, Lag= 0.0 min

Routing by StoR-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Reach IP#2: PROP LINE



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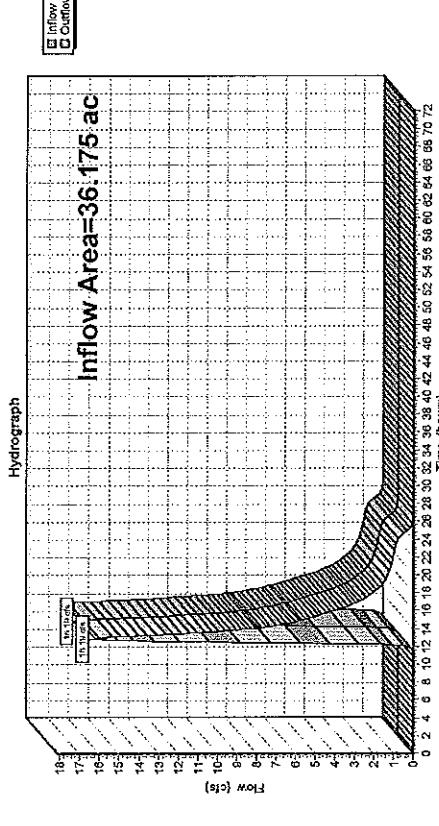
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Summary for Reach IP#3: WETLANDS

Inflow Area = 36.175 ac, 13.65% Impervious, Inflow Depth = 1.27" for 10YR REV event
Inflow = 16.19 cfs @ 12.88 hrs, Volume= 3.832 af
Outflow = 16.19 cfs @ 12.88 hrs, Volume= 3.832 af, Atten= 0%, Lag= 0.0 min

Routing by StoR-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Reach IP#3: WETLANDS



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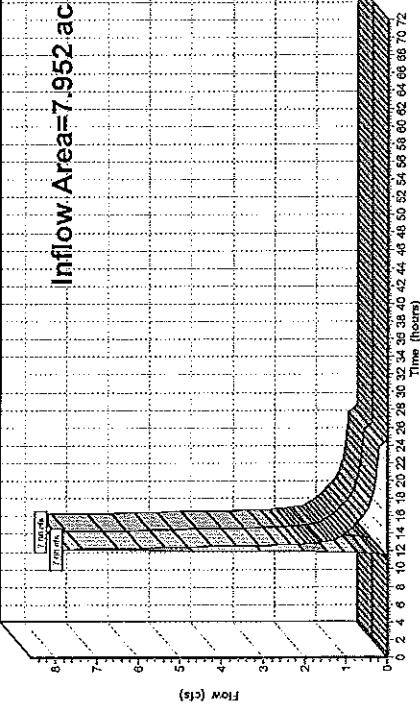
Summary for Reach IP#4: PROP. LINE

Inflow Area = 7.952 ac, 4.43% Impervious, Inflow Depth = 1.24" for 10YR REV event
 Inflow = 7.86 cfs @ 12.23 hrs, Volume= 0.820 af
 Outflow = 7.86 cfs @ 12.23 hrs, Volume= 0.820 af, Atten= 0%, Lag= 0.0 min

Routing by StoR-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

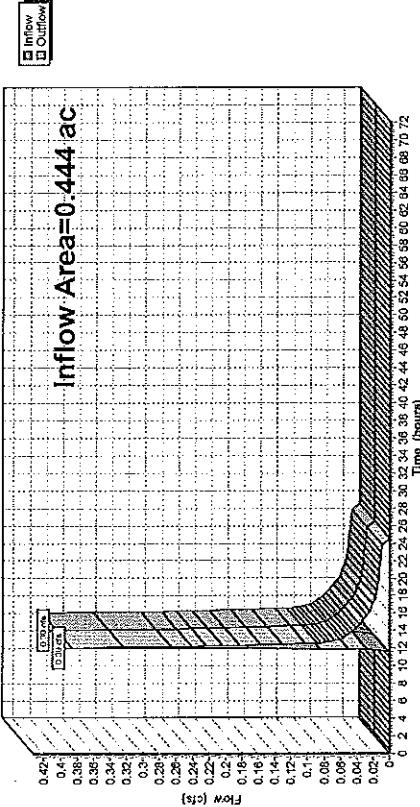
Reach IP#4: PROP. LINE

Hydrograph



Reach IP#5: PROP. LINE

Hydrograph



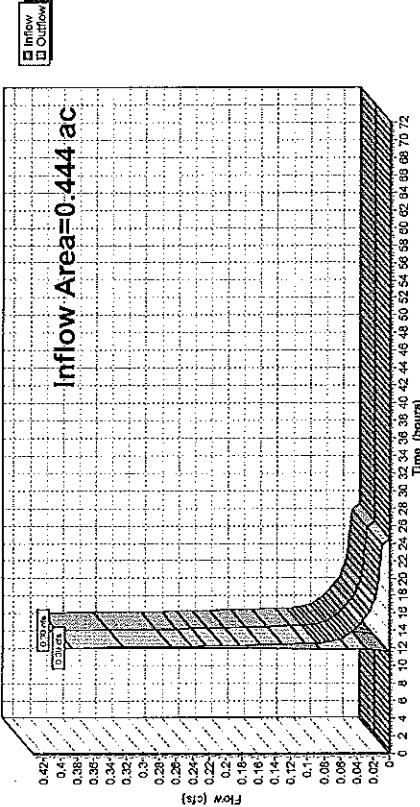
Summary for Reach IP#5: PROP LINE

Inflow Area = 0.444 ac, 0.00% Impervious, Inflow Depth = 0.93" for 10YR REV event
 Inflow = 0.39 cfs @ 12.10 hrs, Volume= 0.034 af
 Outflow = 0.39 cfs @ 12.10 hrs, Volume= 0.034 af, Atten= 0%, Lag= 0.0 min

Routing by StoR-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Reach IP#5: PROP LINE

Hydrograph



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Summary for Pond PND1: BASIN#1

Inflow Area = 8,791 ac. 34.42% Impervious, Inflow Depth = 2.19" for 10YR REV event
 Inflow = 13,90 cfs @ 12.35 hrs, Volume= 1,688 cf
 Outflow = 3,50 cfs @ 13.03 hrs, Volume= 1,608 cf, Attenu= 74%, Lag= 41.0 min
 Discarded = 0.26 cfs @ 13.03 hrs, Volume= 0.455 cf
 Primary = 3.33 cfs @ 13.03 hrs, Volume= 1,142 cf
 Routing by StoR-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
 Peak Elev= 377.08' @ 13.03 hrs Surf.Area= 11,118 sf Storage= 28,066 cf
 Plug-Flow detention time= 209.5 min calculated for 1,606 cf (100% of inflow)
 Center-of-Mass det. time= 210.0 min (1,067.9 - 857.9)

Volume Invert Avail.Storage Storage Description

Volume	Invert	Avail.Storage	Storage Description
#1	374.00	82,639 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Incr.Store (cubic-feet)	Cum.Store (cubic-feet)
374.00	7,184	0	0
376.00	9,666	16,850	16,850
378.00	12,357	22,023	38,873
380.00	15,306	27,663	66,536
381.00	16,900	16,103	82,639

Device Routing Invert Outlet Devices

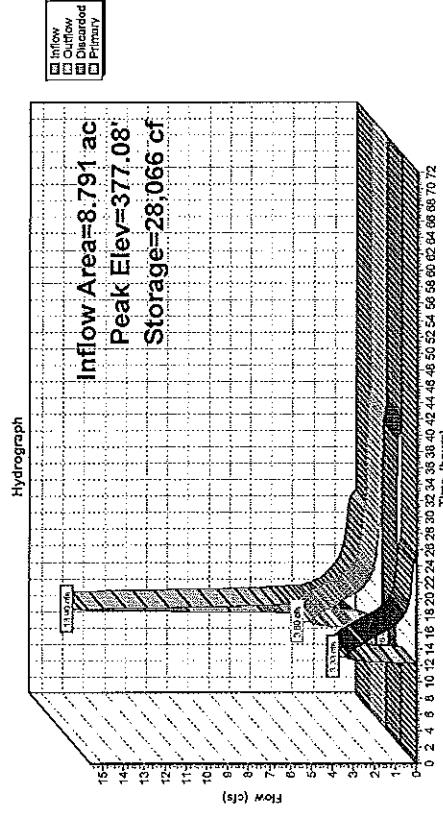
#1	Discarded	374.00	1,020 in/hr Exfiltration over Surface area
#2	Primary	375.00'	6.0" Vert. Orifice/Grate C= 0.600
#3	Primary	375.25'	8.0" Vert. Orifice/Grate C= 0.600
#4	Primary	378.25'	12.0" Vert. Orifice/Grate C= 0.600

Discarded OutFlow Max=0.26 cfs @ 13.03 hrs HW=377.08' (Free Discharge)

Primary OutFlow Max=3.33 cfs @ 13.03 hrs HW=377.08' (Free Discharge)
 1=Exfiltration (Exfiltration Controls 0.26 cfs)
 2=Orifice/Grate (Orifice Controls 1.28 cfs @ 6.51 ps)
 3=Orifice/Grate (Orifice Controls 2.08 cfs @ 5.89 ps)
 4=Orifice/Grate (Controls 0.00 cfs)

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Pond PND1: BASIN#1



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Summary for Pond PND2: BASIN#2

Inflow Area = 8.582 ac, 13.11% Impervious, Inflow Depth = 1.51" for 10YR REV event
 Inflow = 7.02 cfs @ 12.60 hrs, Volume= 1.080 af
 Outflow = 4.44 cfs @ 12.99 hrs, Volume= 1.030 af, Attent= 37%, Lag= 23.4 min
 Discarded = 0.15 cfs @ 12.99 hrs, Volume= 0.128 af
 Primary = 4.29 cfs @ 12.99 hrs, Volume= 0.932 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
 Peak Elev= 371.87' @ 12.99 hrs Surf.Area= 6.233 sf Storage= 9,355 cf

Plug-Flow detention time= 41.4 min calculated for 1.079 af (100% of inflow)
 Center-of-Mass det. time= 41.5 min (337.8 - 896.3)

Volume	Invert	Avail.Storage	Storage Description	Custom Stage Data (Prismatic) Listed below (Recalc)
#1	370.00'	35,650 cf		
Elevation	Surf.Area (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	
370.00	3,750	0	0	
372.00	6,400	10,150	10,150	
374.00	9,300	15,700	25,350	
375.00	10,300	9,800	35,650	

Device Routing Invert Outlet Devices

#1	Discarded	370.00'	1.020 in/hr Exfiltration over Surface area
		370.00'	8.0" Vert. Orifice/Grate C= 0.600
#2	Primary	370.75'	10.0" Vert. Orifice/Grate C= 0.600
#3	Primary	372.85'	12.0" Vert. Orifice/Grate C= 0.600
#4	Primary		

Discarded OutFlow Max=0.15 cfs @ 12.99 hrs HW=371.87' (Free Discharge)

1=Exfiltration (Exfiltration Controls 0.15 cfs)

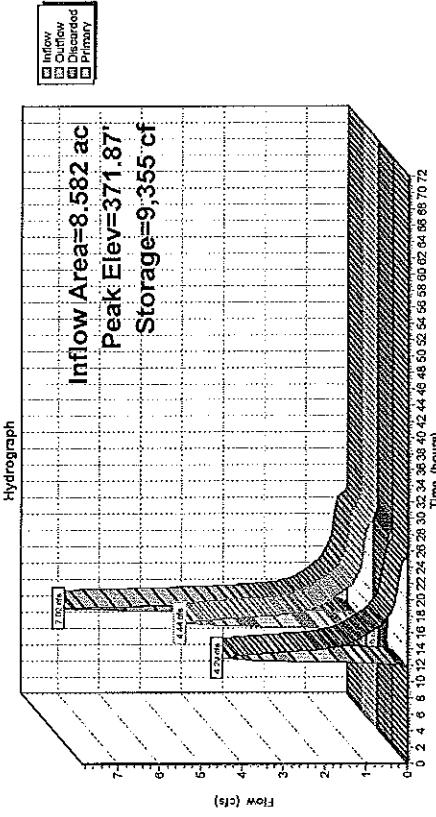
2=Primary OutFlow Max=4.29 cfs @ 12.99 hrs HW=371.87' (Free Discharge)

3=Orifice/Grate (Orifice Controls 2.08 cfs @ 5.98 fps)

4=Orifice/Grate (Orifice Controls 2.21 cfs @ 4.05 fps)

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Pond PND2: BASIN#2



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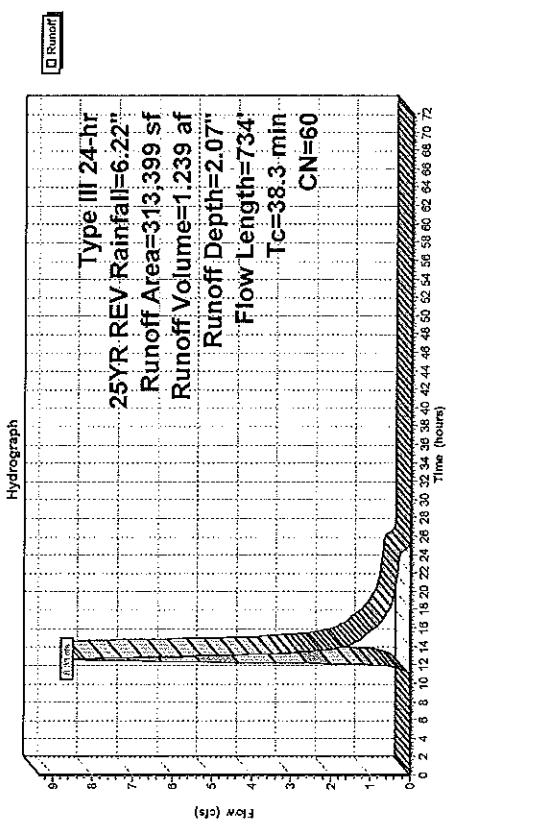
Type III 24-hr 25YR REV Rainfall//=6.22"
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Type III 24-hr 25YR REV Rainfall//=6.22"
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Summary for Subcatchment 1P: DA#1P

Runoff	=	8.33 cfs @ 12.57 hrs, Volume= 1.239 af, Depth= 2.07"			
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span = 0.00-72.00 hrs, dt= 0.05 hrs					
Type III 24-hr 25YR REV Rainfall//=6.22"					
Area (sf)	CN	Description			
24,004	98	Paved parking & roofs			
80,175	61	>75% Grass cover, Good, HSG B			
209,220	55	Woods, Good, HSG B			
313,389	60	Weighted Average			
289,395	92.34%	Pervious Area			
24,004	7.66%	Impervious Area			
Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
28.3	50	0.0100	0.03	Sheet Flow, TRAVEL PATH A TO B	
6.6	375	0.0360	0.95	Woods: Dense underbrush n= 0.800 P2= 3.20"	
0.3	100	0.0150	6.02	Shallow Concentrated Flow, TRAVEL PATH B TO C	
0.3				Woodland Kv= 5.0 lps	
0.8				Pipe Channel, TRAVEL PATH D TO E	
2.3				12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012 Concrete pipe finished	
38.3	734	Total		Shallow Concentrated Flow, TRAVEL PATH E TO F	
				Grassed Waterway Kv= 15.0 lps	
				Shallow Concentrated Flow, TRAVEL PATH F TO G	
				Woodland Kv= 5.0 lps	



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Type III 24-hr 25YR REV Rainfall=6.22"
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Summary for Subcatchment 2P: DA#2P

Runoff = 11.29 cfs @ 12:20 hrs, Volume= 1,069 af, Depth= 2.33"

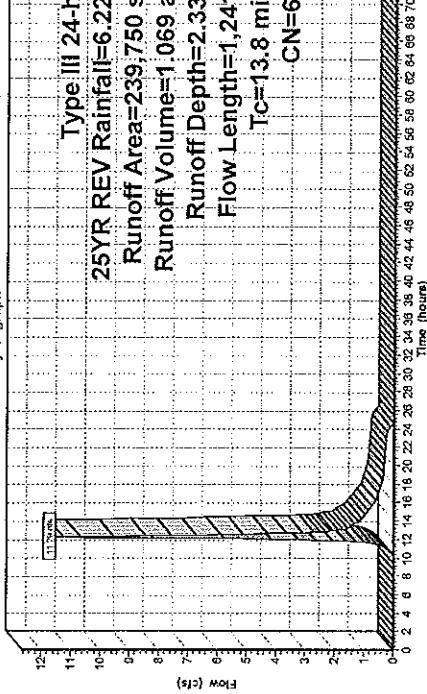
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
 Type III 24-hr 25YR REV Rainfall=6.22"

Area (sf)	CN	Description
23,199	98	Paved parking & roofs
127,802	61	>75% Grass cover, Good, HSG B
88,749	53	Woods/grass comb., Good, HSG B
216,551	63	Weighted Average
23,199	63	90.32% PerVIOUS Area 9.68% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.4	50	0.0100	0.11	Sheet Flow, TRAVEL PATH A TO B	
5.0	1,081	0.0500	3.60	Grass: Short n= 0.150 P2= 3.20" Shallow Concentrated Flow, TRAVEL PATH B TO C	
1.4	110	0.0720	1.34	Unpaved Kv= 16.1 fps Shallow Concentrated Flow, TRAVEL PATH C TO D	
13.8	1,241	Total		Woodland Kv= 5.0 fps	

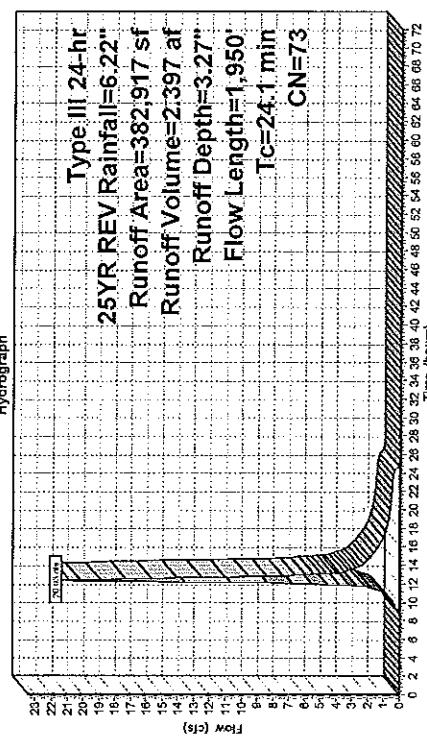
Subcatchment 2P: DA#2P

Hydrograph



Subcatchment 3P: DA#3P

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Type III 24-hr 25YR REV Rainfall=6.22"
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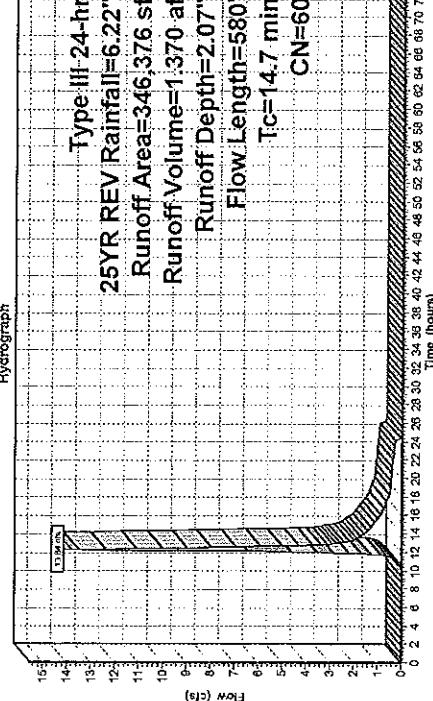
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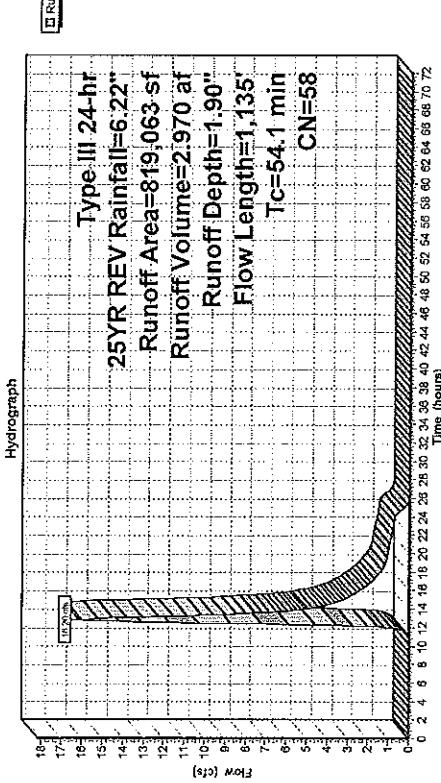
Summary for Subcatchment 4P: DA#4P

Runoff	=	13.84 cfs @ 12.22 hrs, Volume=	1.370 af, Depth= 2.07"
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs			
Type III 24-hr 25YR REV Rainfall=6.22"			
Tc	Length	Slope	Capacity
(min)	(feet)	(ft/ft)	(cfs)
5.1	50	0.0250	0.16
0.3	80	0.0750	4.41
9.3	450	0.0260	0.81
14.7	580	Total	

Subcatchment 4P: DA#4P



Subcatchment 5P: DA#5P



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Type III 24-hr 25YR REV Rainfall=6.22"
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Summary for Subcatchment 5P: DA#5P

Runoff	=	16.20 cfs @ 12.80 hrs, Volume=	2.970 af, Depth= 1.90"
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs			
Type III 24-hr 25YR REV Rainfall=6.22"			
Area (sf)	CN	Description	
15.358	98	Paved parking & roofs	
48.009	61	>75% Grass cover, Good, HSG B	
283.009	58	Wood/grass comb., Good, HSG B	
331.018	60	Weighted Average	
15.358	95.57%	Pervious Area	
331.018	4.43%	Impervious Area	
Tc	Length	Slope	Capacity
(min)	(feet)	(ft/ft)	(cfs)
21.5	50	0.0200	0.04
31.2	935	0.0100	0.50
1.4	150	0.0300	1.73
54.1	1,135	Total	Nearly Bare & Untiled Kv= 10.0 fps

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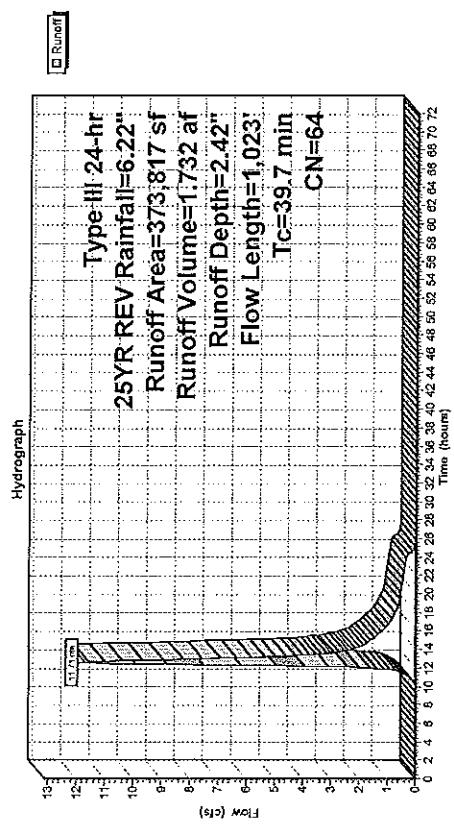
Summary for Subcatchment 6P: 6P

Runoff	=	11.71 cfs @ 12.58 hrs, Volume=	1.732 ac, Depth= 2.42"		
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Type III 24-hr 25YR REV Rainfall=6.22"					
Area (sf)	CN	Description			
49,012	98	Paved parking, HSG B			
206,262	61	>75% Grass cover, Good, HSG B			
118,543	55	Woods, Good, HSG B			
373,817	64	Weighted Average 86.88% Permeable Area 13.11% Impervious Area			
324,805					
49,012					
Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
18.3	50	0.0300	0.05	Sheet Flow, TRAVEL PATH A TO B	
1.6	135	0.0800	1.41	Woods: Dense underbrush n= 0.800 P2= 3.20" Shallow Concentrated Flow, TRAVEL PATH B TO C	
19.4	555	0.0330	0.48	Vegetation Kv= 5.0 fps TrapVee Rect Channel Flow, TRAVEL C TO D	
0.4	283	0.0500	11.99	Bot W=2.00' D=1.00' Z= 2.0' Top W=6.00' n= 0.410 Sheet flow over Bermuda Grass Pipe Channel, TRAVEL PATH D TO E	
				12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.011 Concrete pipe, finished	
39.7	1.023	Total			

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Subcatchment 6P: 6P



Sheet Flow, TRAVEL PATH A TO B
Woods: Dense underbrush n= 0.800 P2= 3.20"
Shallow Concentrated Flow, TRAVEL PATH B TO C
Vegetation Kv= 5.0 fps
TrapVee Rect Channel Flow, TRAVEL C TO D
Bot W=2.00' D=1.00' Z= 2.0' Top W=6.00'
n= 0.410 Sheet flow over Bermuda Grass
Pipe Channel, TRAVEL PATH D TO E
12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25'
n= 0.011 Concrete pipe, finished

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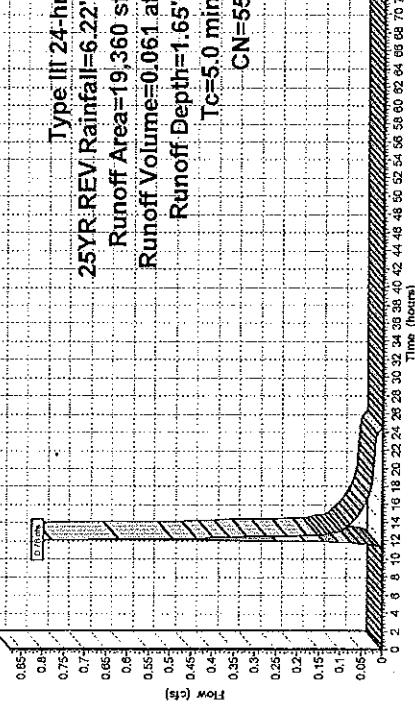
Type III 24-hr 25YR REV Rainfall=6.22"
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Summary for Subcatchment 7P: DA#7P

Runoff	=	0.78 cfs @ 12.09 hrs, Volume=	0.061 af, Depth= 1.65"
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs			
Type III 24-hr 25YR REV Rainfall=6.22"			
Area (sf)	CN	Description	
19,360	55	Woods, Good, HSG B	
		100.00% Previous Area	

Subcatchment 7P: DA#7P

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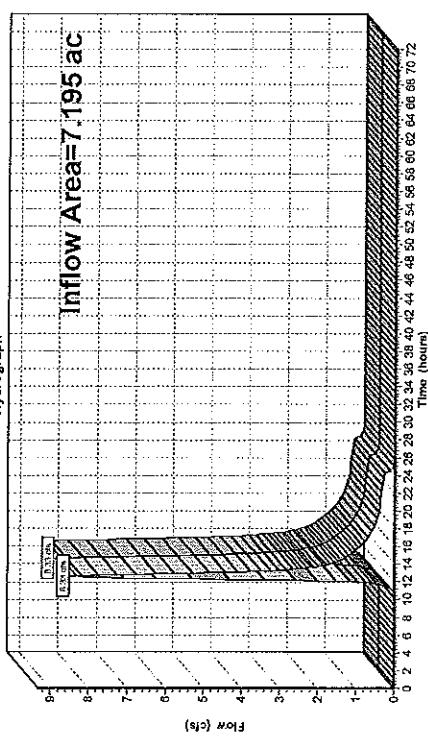
Type III 24-hr 25YR REV Rainfall=6.22"
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Summary for Reach IP#: VERNAL POOL

Inflow Area = 7.195 ac, 7.66% Impervious, Inflow Depth = 2.07" for 25YR REV event
Inflow = 8.33 cfs @ 12.57 hrs, Volume= 1.239 af
Outflow = 8.33 cfs @ 12.57 hrs, Volume= 1.239 af, Attenu= 0%, Lag= 0.0 min
Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Reach IP#1: VERNAL POOL

Hydrograph



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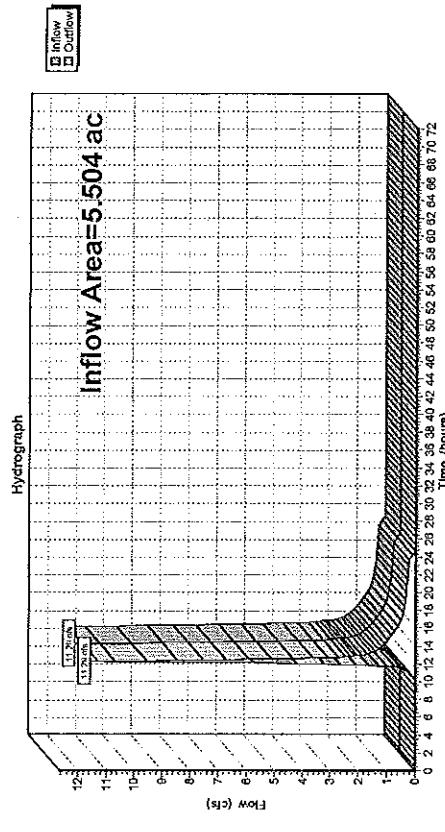
Type III 24-hr 25YR REV Rainfall/=6.22"
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Summary for Reach IP#2: PROP LINE

Inflow Area = 5,504 ac, 9.68% Impervious, Inflow Depth = 2.33" for 25YR REV event
Inflow = 11.29 cfs @ 12.20 hrs, Volume= 1.069 af
Outflow = 11.29 cfs @ 12.20 hrs, Volume= 1.069 af, Atten= 0%, Lag= 0.0 min

Routing by StoR-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Reach IP#2: PROP LINE



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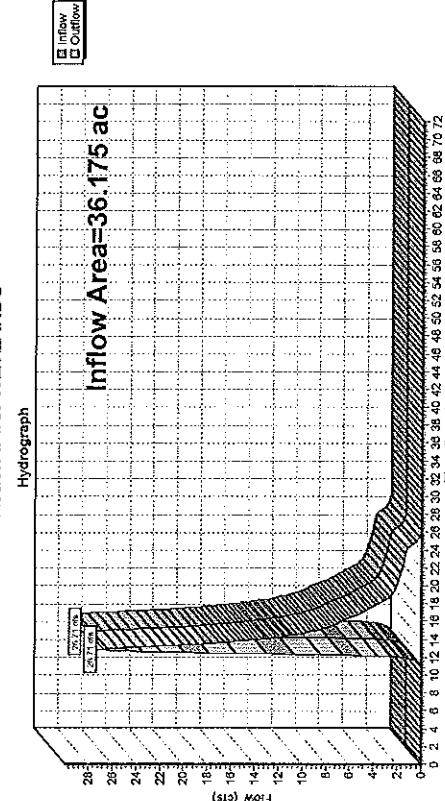
Type III 24-hr 25YR REV Rainfall/=6.22"
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Summary for Reach IP#3: WETLANDS

Inflow Area = 36.175 ac, 13.65% Impervious, Inflow Depth = 2.14" for 25YR REV event
Inflow = 26.71 cfs @ 12.84 hrs, Volume= 6.449 af
Outflow = 26.71 cfs @ 12.84 hrs, Volume= 6.449 af, Atten= 0%, Lag= 0.0 min

Routing by StoR-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Reach IP#3: WETLANDS



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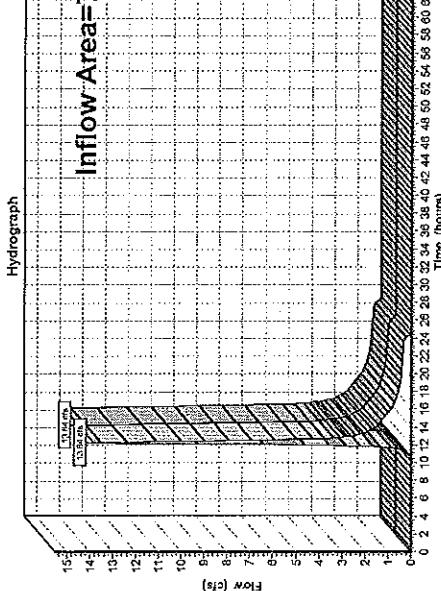
Type III 24-hr 25YR REV Rainfall=6.22"
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Summary for Reach IP#4: PROP. LINE

Inflow Area = 7.952 ac, 4.43% Impervious, Inflow Depth = 2.07" for 25YR REV event
Inflow = 13.84 cfs @ 12.22 hrs, Volume= 1.370 af
Outflow = 13.84 cfs @ 12.22 hrs, Volume= 1.370 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Reach IP#4: PROP. LINE

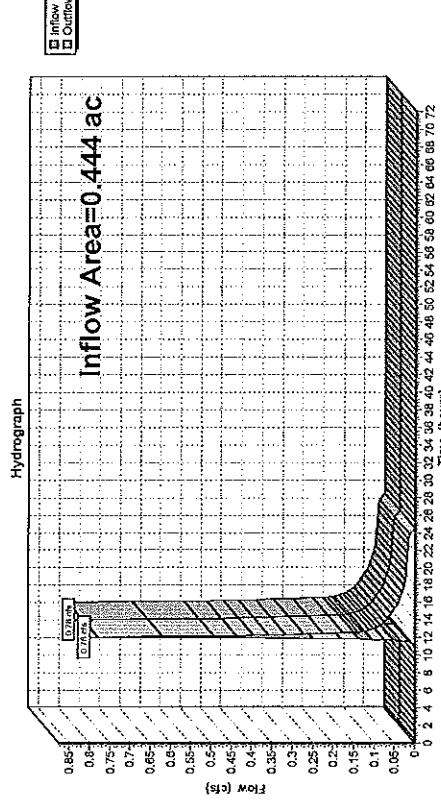


Summary for Reach IP#5: PROP LINE

Inflow Area = 0.444 ac, 0.00% Impervious, Inflow Depth = 1.65" for 25YR REV event
Inflow = 0.78 cfs @ 12.09 hrs, Volume= 0.061 af
Outflow = 0.78 cfs @ 12.09 hrs, Volume= 0.061 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Reach IP#5: PROP LINE



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Summary for Pond PND1: BASIN#1

Inflow Area = 8.791 ac, 34.42% Impervious, Inflow Depth = 3.27" for 25YR REV event
 Inflow = 20.35 cfs @ 12.34 hrs, Volume= 2,397 af
 Outflow = 4.98 cfs @ 13.05 hrs, Volume= 2,397 af, Atten= 78%, Lag= 42.7 min
 Discarded = 0.31 cfs @ 13.05 hrs, Volume= 0.504 af
 Primary = 4.67 cfs @ 13.05 hrs, Volume= 1,893 af
 Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
 Peak Elev= 378.43 @ 13.05 hrs Surf.Area= 12,995 sf Storage= 44,354 cf

Plug-Flow detention time= 186.1 min calculated for 2,397 at (100% of inflow)
 Center-of-Mass det. time= 185.7 min (1,032.0 - 846.3)

Volume	Invert	Avail.Storage	Storage Description
#1	374.00'	82,639 cf	Custom Stage Data (Prismatic) Listed below (Recallc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
374.00	7,184	0	0
376.00	9,666	16,850	16,850
378.00	12,357	22,023	38,873
380.00	15,306	27,663	66,536
381.00	16,900	16,103	82,639

Device Routing Invert Outlet Devices

#1	Discarded	374.00'	1,020 in/hr Exfiltration over Surface area
#2	Primary	375.00'	6.0" Vert. Orifice/Grate C= 0.600
#3	Primary	375.25'	8.0" Vert. Orifice/Grate C= 0.600
#4	Primary	378.25'	12.0" Vert. Orifice/Grate C= 0.600

Discarded OutFlow Max=0.31 cfs @ 13.05 hrs HW=378.43' (Free Discharge)
 1=Exfiltration (Exfiltration Controls 0.31 cfs)

Primary OutFlow Max=4.67 cfs @ 13.05 hrs HW=378.43' (Free Discharge)

2=Orifice/Grate (Orifice Controls 1.69 cfs @ 8.59 fps)

3=Orifice/Grate (Orifice Controls 2.84 cfs @ 8.13 fps)

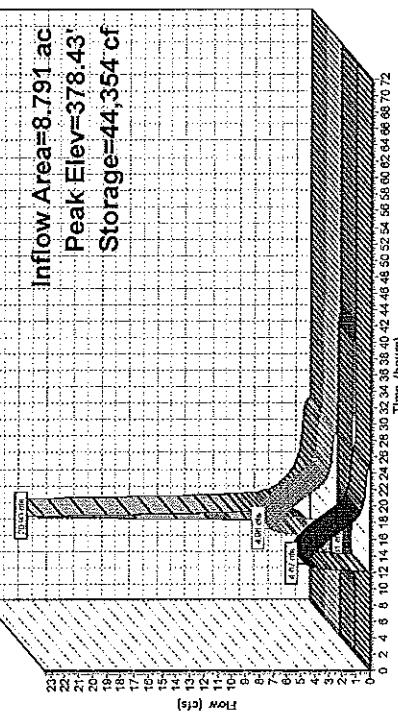
4=Orifice/Grate (Orifice Controls 0.14 cfs @ 1.45 fps)

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Pond PND1: BASIN#1

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Summary for Pond PND2: BASIN#2

Inflow Area = 8,582 ac, 13.11% Impervious, Inflow Depth = 2.42" for 25YR REV event
 Inflow = 11.71 cfs @ 12.58 hrs, Volume= 1,732 af
 Outflow = 6.51 cfs @ 13.04 hrs, Volume= 1,732 af, Attenu= 44%, Lag= 27.5 min
 Discarded = 0.18 cfs @ 13.04 hrs, Volume= 0.145 af
 Primary = 6.33 cfs @ 13.04 hrs, Volume= 1,587 af

Routing by Sto-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
 Peak Elev= 372.97' @ 13.04 hrs Surf.Area= 7,809 sf Storage= 17,053 cf
 Plug-Flow detention time= 41.6 min calculated for 1.731 af (100% of inflow)
 Center-of-Mass det. time= 41.7 min (923.5 - 381.8)

Volume Invert Avail.Storage Storage Description

#1 370.00 35,650 cf Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
370.00	3,750	0	0
372.00	6,400	10,150	10,150
374.00	9,300	15,700	25,850
375.00	10,300	9,800	35,650

Device Routing Invert Outlet Devices

#1 Discarded 370.00' 1,020 in/hr Exfiltration over Surface area
 #2 Primary 370.00' 8.0" Vert. Orifice/Grate C= 0.600
 #3 Primary 370.75' 10.0" Vert. Orifice/Grate C= 0.600
 #4 Primary 372.85' 12.0" Vert. Orifice/Grate C= 0.600

Discarded OutFlow Max=0.18 cfs @ 13.04 hrs HW=372.97' (Free Discharge)

1=Exfiltration (Exfiltration Controls 0.18 cfs)

Primary OutFlow Max=3.32 cfs @ 13.04 hrs HW=372.97' (Free Discharge)

2=Orifice/Grate (Orifice Controls 2.73 cfs @ 7.82 tps)

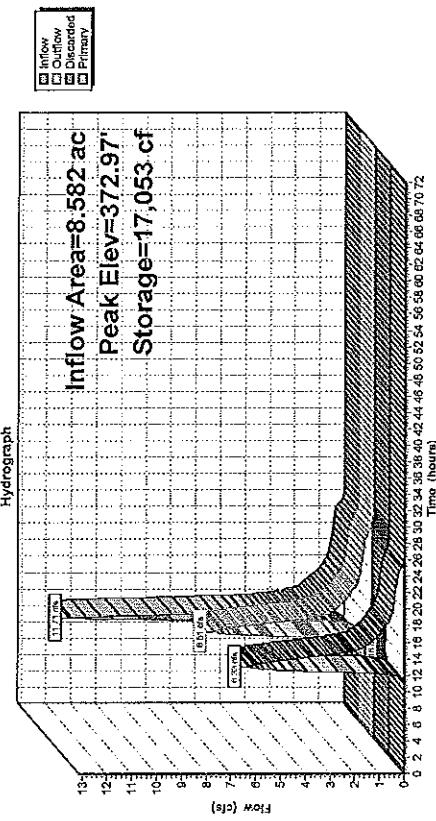
3=Orifice/Grate (Orifice Controls 3.53 cfs @ 6.47 tps)

4=Orifice/Grate (Orifice Controls 0.06 cfs @ 1.18 tps)

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Pond PND2: BASIN#2



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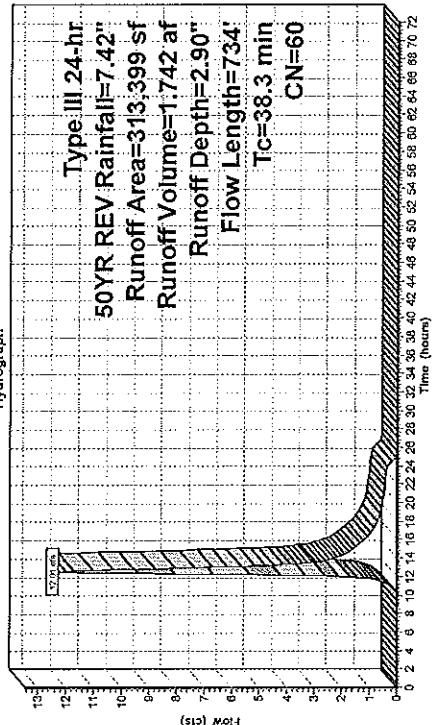
Type III 24-hr 50YR REV Rainfall = 7.42" Printed 9/13/2017 Page 58
Ions LLC

Summary for Subcatchment 1P: DA#1P

Runoff	=	12.01 cfs @ 12.56 hrs, Volume=	1,742 acf, Depth= 2.90"		
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs					
Type III 24-hr 50YR REV Rainfall=7.42"					
Area (sf)	CN	Description			
24,004	98	Paved parking & roofs			
8,0175	61	>75% Grass cover, Good, HSG B			
209,220	55	Woods, Good, HSG B			
313,399	60	Weighted Average			
289,395		92.34% Pervious Area			
24,004		7.66% Impervious Area			
Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
28.3	50	0.0100	0.03		Sheet Flow, TRAVEL PATH A TO B
6.6	375	0.0350	0.95		Woods: Dense underbrush, n= 0.800 P2=3.20"
0.3	100	0.0150	6.02	4.73	Shallow Concentrated Flow, TRAVEL PATH B TO C Woodland Kv= 5.0 tps
0.8	89	0.0150	1.84		Pipe Channel, TRAVEL PATH D TO E 12.0" Round Area= 0.8 sf Penetr= 3.1' r= 0.25' n= 0.012 Concrete pipe, finished
2.3	120	0.0300	0.87		Shallow Concentrated Flow, TRAVEL PATH E TO F Grassed Waterway Kv= 15.0 tps
					Shallow Concentrated Flow, TRAVEL PATH F TO G Woodland Kv= 5.0 tps

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Subcatchment 1P: DA#1P



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Type III 24-hr 50YR REV Rainfall=7.42"

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 Type III 24-hr 50YR REV Rainfall=7.42"

Summary for Subcatchment 2P: DA#2P

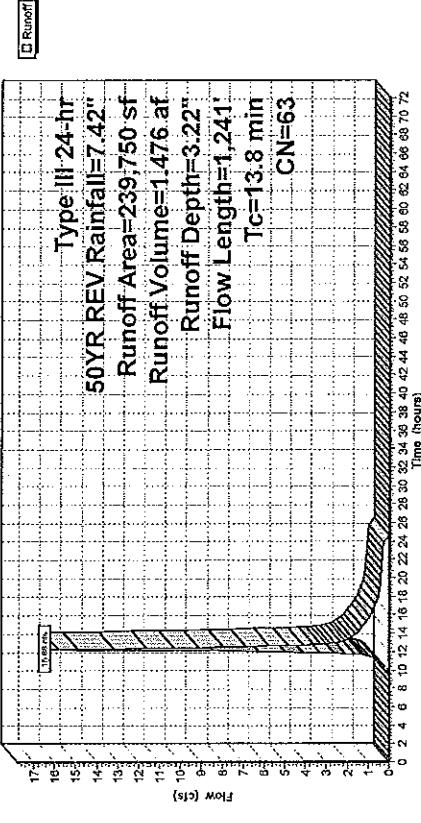
$$\text{Runoff} = 15.88 \text{ cfs} @ 12.20 \text{ hrs, Volume=} 1.476 \text{ af, Depth=} 3.22"$$

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
 Type III 24-hr 50YR REV Rainfall=7.42"

Area (sf)	CN	Description	Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
23,199	98	Paved parking & roofs	7.4	50	0.0100	0.11	Sheet Flow, TRAVEL PATH A TO B	Type III 24-hr
127,802	61	>75% Grass cover, Good, HSG B	5.0	1,081	0.0500	3.60	Grass: Short n= 0.150 P= 3.20"	50YR REV Rainfall=7.42"
88,749	58	Wood/grass comb., Good, HSG B	1.4	110	0.0720	1.34	Shallow Concentrated Flow, TRAVEL PATH B TO C Unpaved Kv= 16.1 fps Shallow Concentrated Flow, TRAVEL PATH C TO D Woodland Kv= 5.0 fps	Runoff Area=329,750 sf Runoff Volume=1,476 af Runoff Depth=3.22"
23,199	63	Weighted Average 90.32% Pervious Area 9.68% Impervious Area	13.8	1,241	Total			Flow Length=1,241' Tc=13.8 min CN=63

Subcatchment 2P: DA#2P

Hydrograph

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Type III 24-hr 50YR REV Rainfall=7.42"

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 Type III 24-hr 50YR REV Rainfall=7.42"

Summary for Subcatchment 3P: DA#3P

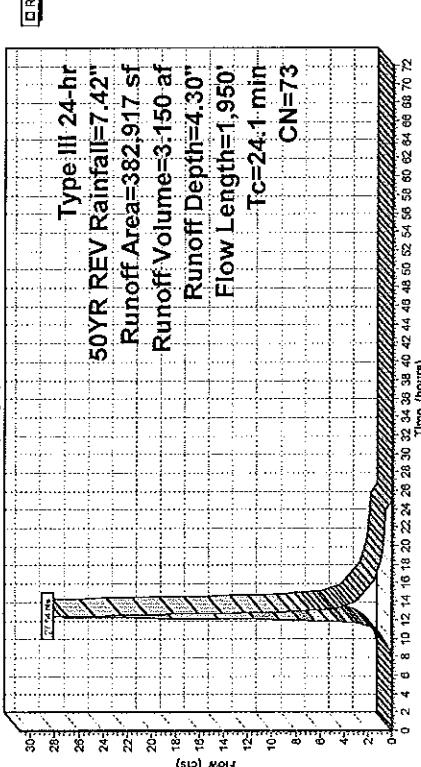
$$\text{Runoff} = 27.54 \text{ cfs} @ 12.33 \text{ hrs, Volume=} 3.150 \text{ af, Depth=} 4.30"$$

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
 Type III 24-hr 50YR REV Rainfall=7.42"

Area (sf)	CN	Description	Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
131,794	98	Paved parking & roofs	16.3	50	0.0400	0.05	Sheet Flow, TRAVEL PATH A TO B	Type III 24-hr
182,960	61	>75% Grass cover, Good, HSG B	0.8	200	0.0600	3.94	Woods: Dense underbrush n= 0.800 P= 3.20"	50YR REV Rainfall=7.42"
68,163	55	Woods, Good, HSG B	7.0	1,700	0.0400	4.06	Shallow Concentrated Flow, TRAVEL PATH B TO C Unpaved Kv= 16.1 fps Shallow Concentrated Flow, TRAVEL PATH C TO D	Runoff Area=382,917 sf Runoff Volume=3,150 af Runoff Depth=4.30"
382,917	73	Weighted Average	24.1	1,950	Total			Flow Length=1,950' Tc=24.1 min CN=73

Subcatchment 3P: DA#3P

Hydrograph



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Type III 24-hr 50YR REV Rainfall=7.42"
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Summary for Subcatchment 4P: DA#4P

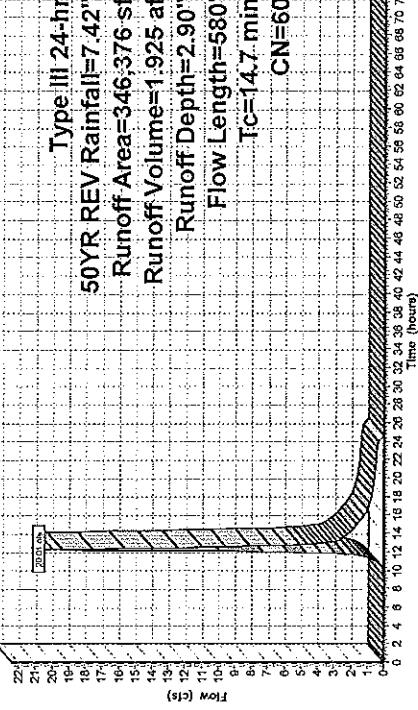
Runoff = 20.01 cfs @ 12.21 hrs, Volume= 1.925 af, Depth= 2.90"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span=0.00-72.00 hrs, dt= 0.05 hrs
 Type III 24-hr 50YR REV Rainfall=7.42"

Area (sf)	CN	Description			
15,358	98	Paved parking & roofs			
48,009	61	>75% Grass cover, Good, HSG B			
283,009	58	Wood/grass comb., Good, HSG B			
346,376	60	Weighted Average 55.57% Pervious Area			
331,018		4.43% Impervious Area			
15,358					
Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.1	50	0.0250	0.16	Sheet Flow, TRAVEL PATH A TO B Grass: Short n= 0.150 P2= 3.20"	
0.3	80	0.0750	4.41	Shallow Concentrated Flow, TRAVEL PATH B TO C Umpaved Kv= 16.1 tps	
9.3	450	0.0260	0.81	Shallow Concentrated Flow, TRAVEL PATH C TO D Woodland Kv= 5.0 tps	
14.7	580				Total

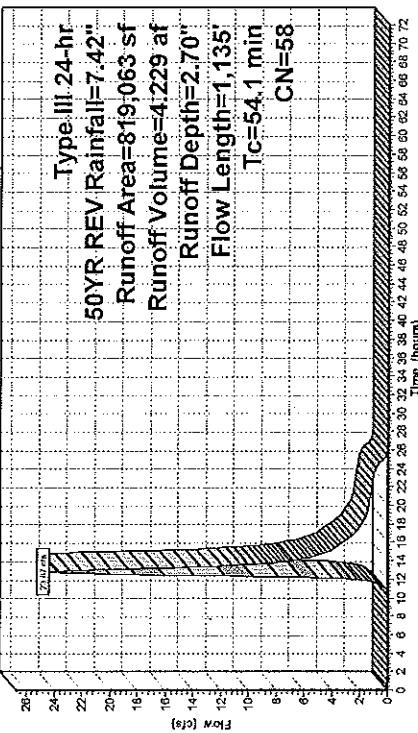
Subcatchment 4P: DA#4P

Hydrograph



Subcatchment 5P: DA#5P

Hydrograph



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Type III 24-hr 50YR REV Rainfall=7.42"
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Summary for Subcatchment 5P: DA#5P

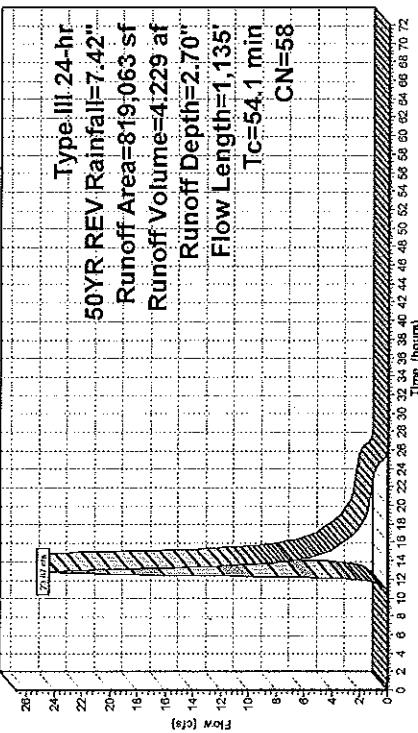
Runoff = 23.87 cfs @ 12.78 hrs, Volume= 4.229 af, Depth= 2.70"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
 Type III 24-hr 50YR REV Rainfall=7.42"

Area (sf)	CN	Description			
34,219	98	Paved parking, HSG A			
153,138	61	>75% Grass cover, Good, HSG B			
631,705	55	Woods, Good, HSG B			
819,063	58	Weighted Average 95.82% Pervious Area			
34,219		4.18% Impervious Area			
Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
21.5	50	0.0200	0.04	Sheet Flow, TRAVEL PATH A TO B Woods: Dense underbrush n= 0.800 P2= 3.20"	
31.2	935	0.0100	0.50	Shallow Concentrated Flow, TRAVEL PATH B TO C Woodland Kv= 5.0 fps	
1.4	150	0.0300	1.73	Shallow Concentrated Flow, TRAVEL PATH C TO D Nearly Bare & Untilled Kv= 10.0 fps	
54.1	1,135				Total

Subcatchment 5P: DA#5P

Hydrograph



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Type III 24-hr 50YR REV Rainfall=7.42"
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Summary for Subcatchment 6P: 6P

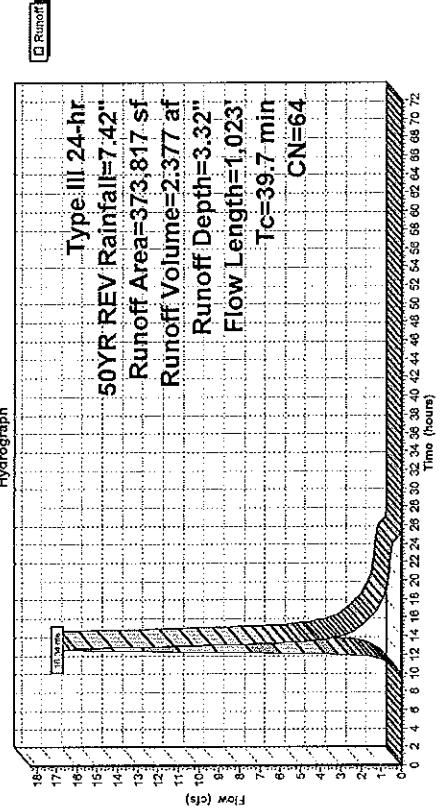
Runoff	=	16.34 cfs @ 12.57 hrs, Volume=	2,377 af, Depth= 3.32"
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs			
Type III 24-hr 50YR REV Rainfall=7.42"			
Area (sf)	CN	Descriptions	
49,012	98	Paved parking, HSG B	
206,262	61	>75% Grass cover, Good, HSG B	
118,543	55	Woods, Good, HSG B	
373,817	64	Weighted Average	
324,805		86.89% Pervious Area	
49,012		13.11% Impervious Area	
Tc	Length	Slope	Velocity Capacity Description
(min)	(feet)	(ft/ft)	(ft/sec) (cfs)
18.3	50	0.0300	0.05 Sheet Flow, TRAVEL PATH A TO B
			V Woods: Dense underbrush r= 0.800 P2= 3.20"
1.6	135	0.0800	1.41 Shallow Concentrated Flow, TRAVEL PATH B TO C
			Woodland Kv= 5.0 lps
19.4	555	0.0330	0.48 1.91 TrapNet/Rect Channel Flow, TRAVEL C TO D
			Bot.W=2.00' D=1.00' Z=2.0' Top.W=6.00'
0.4	283	0.0500	11.99 9.42 Sheet Flow over Bermuda Grass
			n= 0.410 Pipe Channel, TRAVEL PATH D TO E
			12.0" Round Area= 0.8 sf Penin= 3.1' l= 0.25'
			n= 0.011 Concrete pipe, finished
39.7	1.023	Total	

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Type III 24-hr 50YR REV Rainfall=7.42"
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Subcatchment 6P: 6P

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Runoff

Type III 24-hr Rainfall=7.42"

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Type III 24-hr 50YR REV Rainfall=7.42"
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Summary for Subcatchment 7P: DA#7P

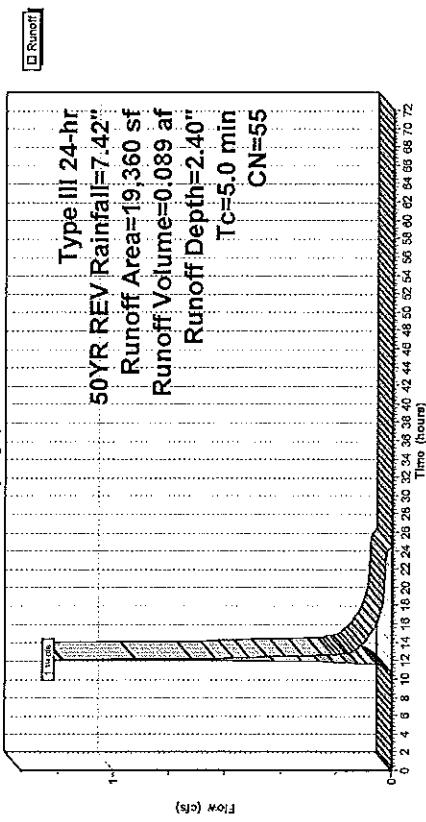
Runoff = 1.19 cfs @ 12.09 hrs, Volume= 0.089 af, Depth= 2.40"
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 50YR REV Rainfall=7.42"

Area (sf)	CN	Description
19,360	55	Woods, Good, HSG B
19,360		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry, TRAVEL TIME

Subcatchment 7P: DA#7P

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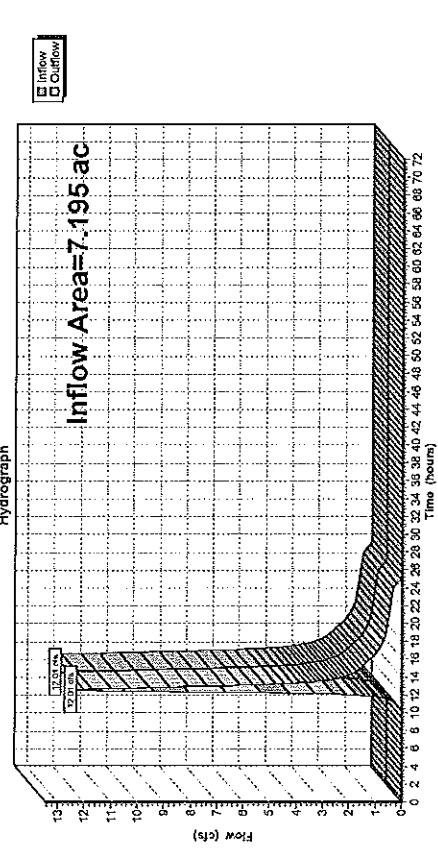
Type III 24-hr 50YR REV Rainfall=7.42"
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Summary for Reach IP#: VERNAL POOL

Inflow Area = 7.195 ac, 7.66% Impervious, Inflow Depth = 2.90" for 50YR REV event
Inflow = 12.01 cfs @ 12.56 hrs, Volume= 1.742 af
Outflow = 12.01 cfs @ 12.56 hrs, Volume= 1.742 af, Attenu= 0%, Lag= 0.0 min
Routing by StoR-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Reach IP#1: VERNAL POOL

Hydrograph



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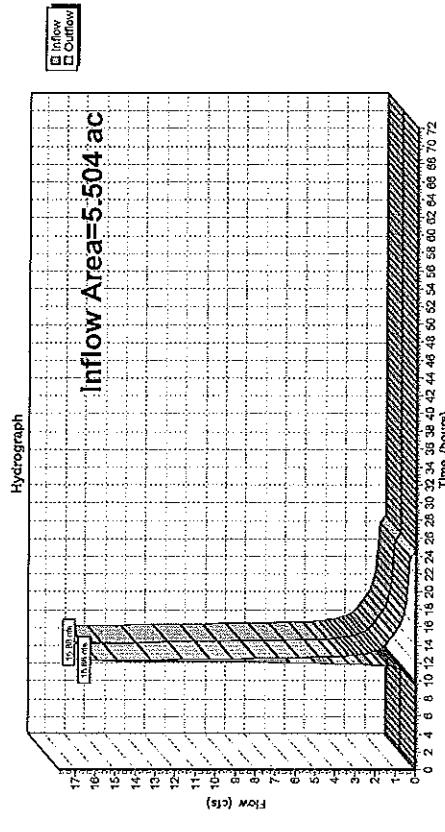
Type III 24-hr 50YR REV Rainfall=7.42"
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Summary for Reach IP#2: PROP LINE

Inflow Area = 5.504 ac, 9.68% Impervious, Inflow Depth = 3.22" for 50YR REV event
Inflow = 15.88 cfs @ 12.20 hrs, Volume= 1.476 af
Outflow = 15.88 cfs @ 12.20 hrs, Volume= 1.476 af, Atten= 0%, Lag= 0.0 min

Routing by StoR-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Reach IP#2: PROP LINE



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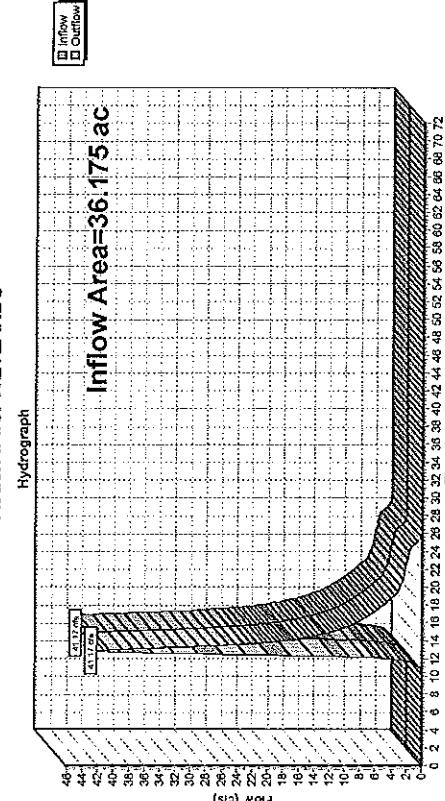
Type III 24-hr 50YR REV Rainfall=7.42"
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Summary for Reach IP#3: WETLANDS

Inflow Area = 36.175 ac, 13.65% Impervious, Inflow Depth = 3.01" for 50YR REV event
Inflow = 41.17 cfs @ 12.83 hrs, Volume= 9.055 af
Outflow = 41.17 cfs @ 12.83 hrs, Volume= 9.055 af, Atten= 0%, Lag= 0.0 min

Routing by StoR-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Reach IP#3: WETLANDS



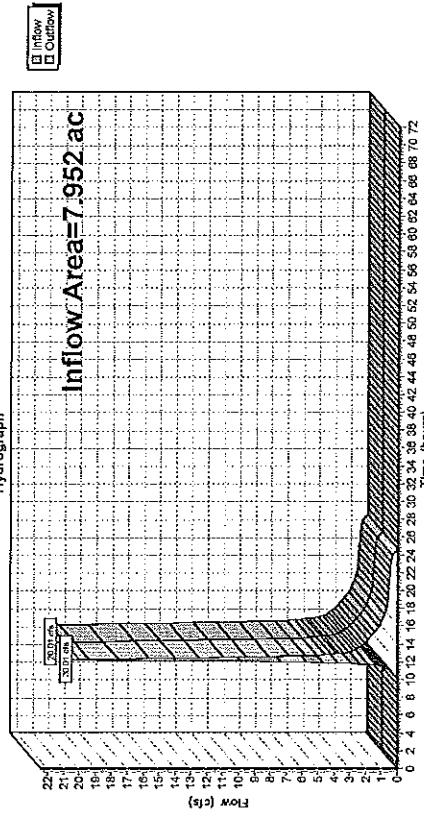
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Summary for Reach IP#4: PROP. LINE

Inflow Area = 7.952 ac, 4.43% Impervious, Inflow Depth = 2.90" for 50YR REV event
Inflow = 20.01 cfs @ 12.21 hrs, Volume= 1.925 af
Outflow = 20.01 cfs @ 12.21 hrs, Volume= 1.925 af, Atten= 0%, Lag= 0.0 min
Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

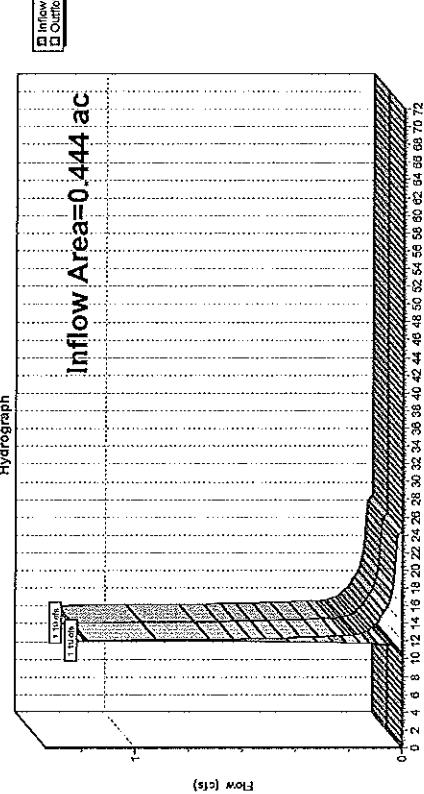
Reach IP#4: PROP. LINE



Summary for Reach IP#5: PROP. LINE

Inflow Area = 0.444 ac, 0.00% Impervious, Inflow Depth = 2.40" for 50YR REV event
Inflow = 1.19 cfs @ 12.09 hrs, Volume= 0.089 af
Outflow = 1.19 cfs @ 12.09 hrs, Volume= 0.089 af, Atten= 0%, Lag= 0.0 min
Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Reach IP#5: PROP. LINE



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Summary for Pond PND1: BASIN#1

Inflow Area = 8.791 ac, 34.42% Impervious, Inflow Depth = 4.30" for 50YR REV event
 Inflow = 27.54 cfs @ 12.33 hrs, Volume= 3,130 af
 Outflow = 8.45 cfs @ 12.90 hrs, Volume= 3,150 af, Attent= 69%, Lag= 34.0 min
 Discarded = 0.34 cfs @ 12.90 hrs, Volume= 0.532 af
 Primary = 8.11 cfs @ 12.90 hrs, Volume= 2,678 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
 Peak Elev= 379.35' @ 12.90 hrs Surf.Area= 14,349 sf Storage= 56,915 cf

Plug-Flow detention time= 166.7 min calculated for 3.148 af (100% of inflow)
 Center-of-Mass det. time= 167.3 min (1.005.7 - 938.4)

Volume	Invert	Avail.Storage	Storage Description	Custom Stage Data (Prismatic) Listed below (Recalc)
#1	374.00'	82,639 cf		

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
374.00	7,184	0	0
376.00	9,666	16,850	16,850
378.00	12,357	22,023	38,873
380.00	15,306	27,663	66,536
381.00	16,900	16,103	82,639

Device	Routing	Invert	Outlet Devices
#1	Discarded	374.00'	1,020 in/hr Exfiltration over Surface area
#2	Primary	375.00'	6.0" Vert. Orifice/Grate C= 0.600
#3	Primary	375.25'	8.0" Vert. Orifice/Grate C= 0.600
#4	Primary	378.25'	12.0" Vert. Orifice/Grate C= 0.600

Discarded OutFlow Max=0.34 cfs @ 12.90 hrs HW=379.35' (Free Discharge)
 1=Exfiltration (Exfiltration Controls 0.34 cfs)

Primary OutFlow Max=8.11 cfs @ 12.90 hrs HW=379.35' (Free Discharge)

2=Orifice/Grate (Orifice Controls 1.91 cfs @ 9.75 ips)

3=Orifice/Grate (Orifice Controls 3.26 cfs @ 9.35 ips)

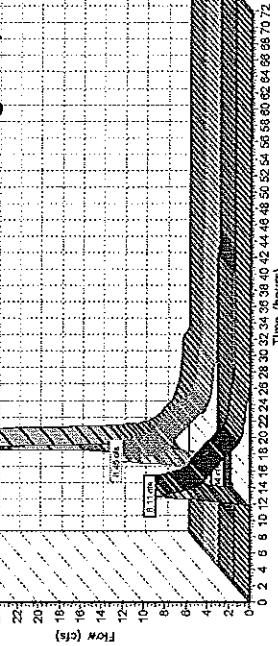
4=Orifice/Grate (Orifice Controls 2.93 cfs @ 3.73 ips)

Pond PND1: BASIN#1



Inflow Area=8.791 ac
 Peak Elev=379.35'
 Storage=56,915 cf

Hydrograph



Hydrograph

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Summary for Pond PND2: BASIN#2

Inflow Area = 8.582 ac, 13.11% Impervious, Inflow Depth = 3.32" for 50YR REV event
 Inflow = 16.34 cfs @ 12.57 hrs, Volume= 2,377 cf
 Outflow = 9.99 cfs @ 12.97 hrs, Volume= 2,377 cf, Attent= 39%, Lag= 23.9 min
 Discarded = 0.21 cfs @ 12.97 hrs, Volume= 0.150 af
 Primary = 9.78 cfs @ 12.97 hrs, Volume= 2,218 af

Routing by Stoer-Lind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
 Peak Elev= 373.76' @ 12.97 hrs Surf.Area= 8.954 sf Storage= 23,674 cf
 Plug-Flow detention time= 41.1 min calculated for 2.376 at (100% of inflow)
 Center-of-Mass det. time= 41.2 min (913.6 - 872.5)

Volume	Invert	Avail.Storage	Storage Description
#1	370.00'	35,650 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
370.00	3,750	0	0
372.00	6,400	10,150	10,150
374.00	9,300	15,700	25,850
375.00	10,300	9,800	35,650

Device	Routing	Invert	Outlet Devices
--------	---------	--------	----------------

#1	Discarded	370.00'	1,020 in/hr Exfiltration over Surface area
#2	Primary	370.00'	8.0" Vert. Orifice/Grate C= 0.600
#3	Primary	370.75'	10.0" Vert. Orifice/Grate C= 0.600
#4	Primary	372.85'	12.0" Vert. Orifice/Grate C= 0.600

Discarded OutFlow Max=0.21 cfs @ 12.97 hrs HW=373.76' (Free Discharge)

1=Exfiltration (Exfiltration Controls 0.21 cfs)

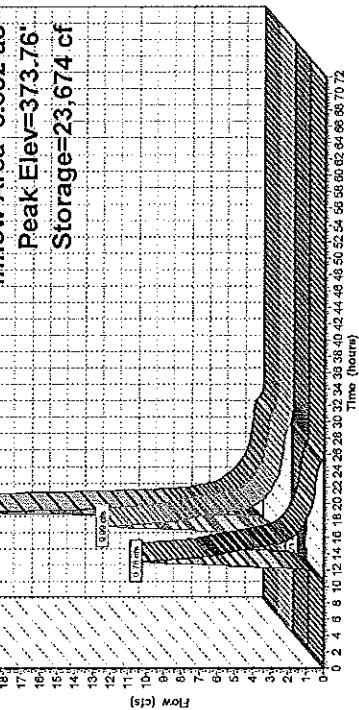
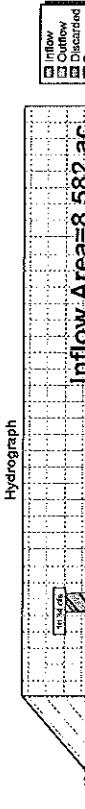
Primary OutFlow Max=9.78 cfs @ 12.97 hrs HW=373.76' (Free Discharge)

2=Orifice/Grate (Orifice Controls 3.11 cfs @ 8.91 ips)

3=Orifice/Grate (Orifice Controls 4.23 cfs @ 7.75 ips)

4=Orifice/Grate (Orifice Controls 2.44 cfs @ 3.25 ips)

Pond PND2: BASIN#2



Type III 24-hr 50YR REV Rainfall=7.42"

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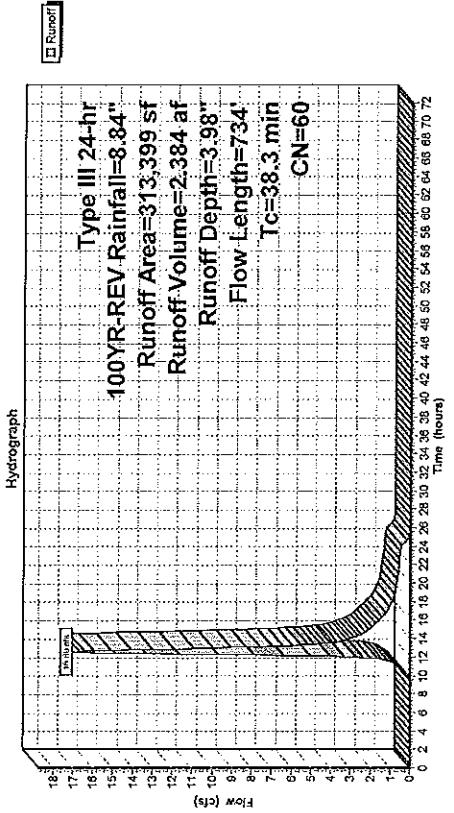
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Type III 24-hr 100YR-REV Rainfall=8.84"
 Type III 24-hr 100YR-REV Rainfall=8.84"
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Summary for Subcatchment 1P: DA#1P

Runoff	=	16.69 cfs @ 12.55 hrs, Volume=	2.384 af, Depth= 3.98"
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span = 0.00-72.00 hrs, dt= 0.05 hrs			
Type III 24-hr 100YR-REV Rainfall=8.84"			
Area (sf)	CN	Description	
24,004	98	Paved parking & roofs	
80,175	61	>75% Grass cover, Good, HSG B	
209,220	55	Woods, Good, HSG B	
313,399	60	Weighted Average	
289,395		92.34% Pervious Area	
24,004		7.66% Impervious Area	
Tc	Length	Slope	Velocity
(min)	(feet)	(ft/ft)	(ft/sec)
28.3	50	0.0100	0.03
6.6	375	0.0360	0.95
0.3	100	0.0150	6.02
0.8	89	0.0150	1.84
2.3	120	0.0300	0.87
38.3	734	Total	
Sheet Flow, TRAVEL PATH A TO B Woods: Dense underbrush n= 0.800 P2= 3.20" Shallow Concentrated Flow, TRAVEL PATH B TO C Woodland Kv= 5.0 tps			
Pipe Channel, TRAVEL PATH D TO E 12.0' Round Area= 0.8 sf Perlin= 3.1' = 0.25' n= 0.012 Concrete pipe, finished			
Shallow Concentrated Flow, TRAVEL PATH E TO F Grassed Waterway Kv= 15.0 tps			
Shallow Concentrated Flow, TRAVEL PATH F TO G Woodland Kv= 5.0 tps			

Subcatchment 1P: DA#1P



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Type III 24-hr 100YR-REV Rainfall=8.84"
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Type III 24-hr 100YR-REV Rainfall=8.84"
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Summary for Subcatchment 2P: DA#2P

Runoff = 21.63 cfs @ 12.20 hrs, Volume= 1.981 af, Depth= 4.34"

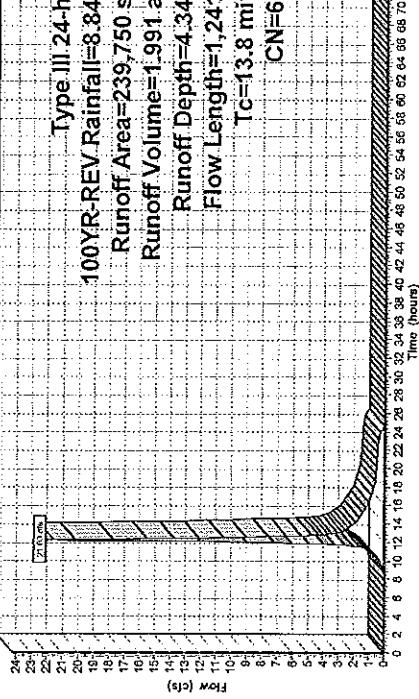
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100YR-REV Rainfall=8.84"

Area (sf)	CN	Description
23,199	98	Paved parking & roofs
127,802	61	>75% Grass cover, Good, HSG B
88,749	58	Woods/grass comb., Good, HSG B
239,750	63	Weighted Average
216,551	90	9.32% Pervious Area
23,199	9	9.68% Impervious Area
Tc		
(min)	Length (feet)	Slope (ft/ft)
7.4	50	0.0100
5.0	1,081	0.0500
1.4	110	0.0720
13.8	1,241	Total

Tc	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.4	50	0.0100	0.11	Sheet Flow, TRAVEL PATH A TO B	
5.0	1,081	0.0500	3.60	Grass: Short n= 0.150 P2= 3.20"	
1.4	110	0.0720	1.34	Shallow Concentrated Flow, TRAVEL PATH B TO C Unpaved Kv= 16.1 tps	
13.8	1,241	Total		Shallow Concentrated Flow, TRAVEL PATH C TO D Woodland Kv= 5.0 tps	

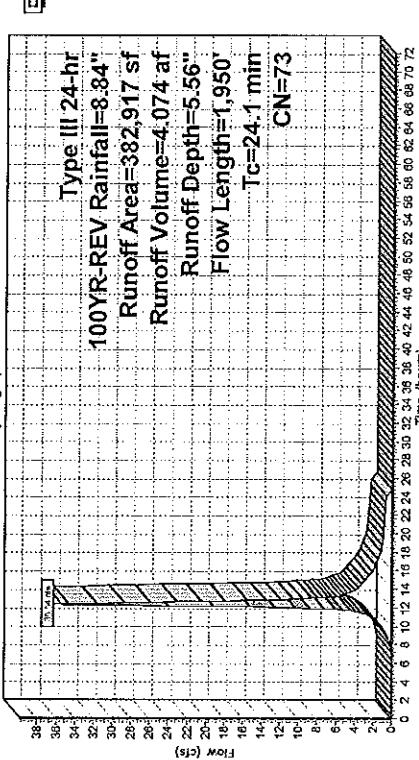
Subcatchment 2P: DA#2P

Hydrograph



Subcatchment 3P: DA#3P

Hydrograph



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Type III 24-hr 100YR-REV Rainfall=8.84"
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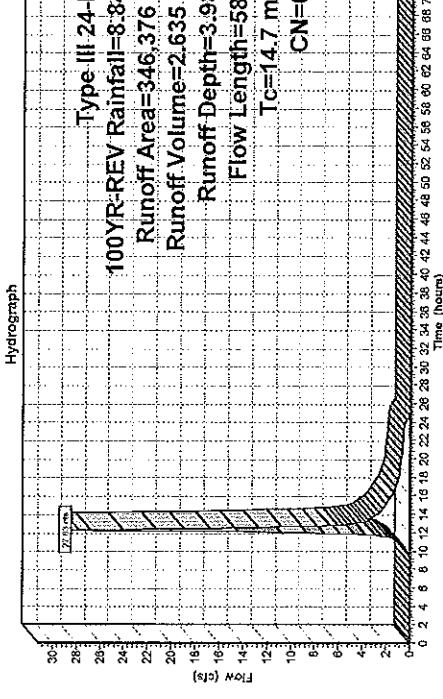
Type III 24-hr 100YR-REV Rainfall=8.84"
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Summary for Subcatchment 4P: DA#4P

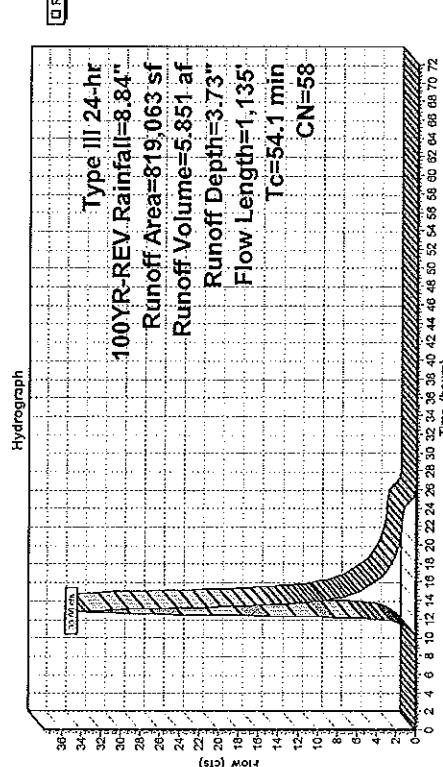
Runoff = 27.83 cfs @ 12.21 hrs, Volume= 2,635 sf, Depth= 3.98"
 Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
 Type III 100YR-REV Rainfall=8.84"

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.1	50	0.0250	0.16	Sheet Flow, TRAVEL PATH A TO B	
0.3	80	0.0750	4.41	Grass: Short n= 0.150 P2= 3.20" Shallow Concentrated Flow, TRAVEL PATH B TO C	
9.3	450	0.0260	0.81	Unpaved Kv= 16.1 fps Shallow Concentrated Flow, TRAVEL PATH C TO D	
14.7	580	Total		V Woodland Kv= 5.0 fps	

Subcatchment 4P: DA#4P



Subcatchment 5P: DA#5P



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Type III 24-hr 100YR-REV Rainfall=8.84"
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Type III 24-hr 100YR-REV Rainfall=8.84"
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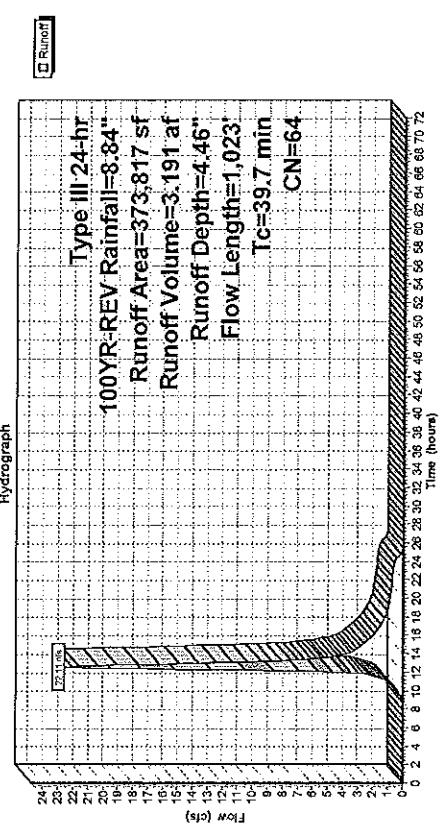
Type III 24-hr 100YR-REV Rainfall=8.84"
Printed 9/13/2017
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Summary for Subcatchment 6P: 6P

Runoff = 22.11 cfs @ 12.56 hrs, Volume= 3,191 af, Depth= 4.46"
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100YR-REV Rainfall=8.84"

Area (sf)	CN	Description
49,012	98	Paved parking, HSG B
206,262	61	>75% Grass cover, Good, HSG B
118,543	55	Woods, Good, HSG B
373,817	64	Weighted Average
324,805	86.89%	Pervious Area
49,012	13.11%	Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
18.3	50	0.0300	0.05	Sheet Flow, TRAVEL PATH A TO B	
1.6	135	0.0800	1.41	V-Woods: Dense underbrush n= 0.800 P2= 3.20"	
19.4	555	0.0330	0.48	Shallow Concentrated Flow, TRAVEL PATH B TO C Woodland Kv= 5.0 tps	
0.4	283	0.0500	11.99	TrapNet/Rect Channel Flow, TRAVEL C TO D Bot,W=2.00' Z=2.0' Top,W=6.00' n= 0.4-10 Sheet flow over Bermuda Grass	
39.7	1,023	Total		Pipe Channel, TRAVEL PATH D TO E 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.011 Concrete Pipe, finished	



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Type III 24-hr 100YR-REV Rainfall=8.84"
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Summary for Subcatchment 7P: DA#7P

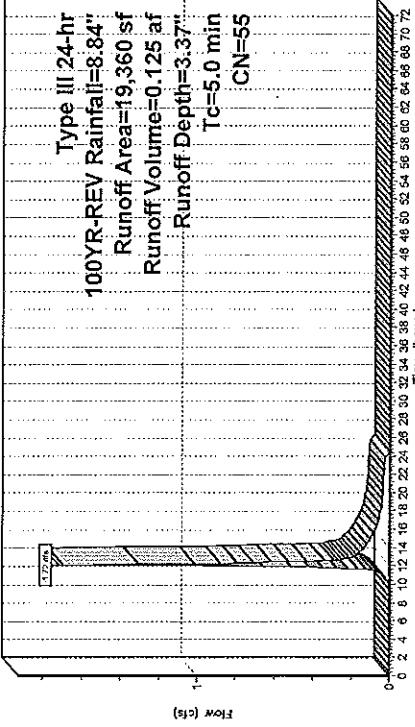
Runoff = 1.72 cfs @ 12.08 hrs, Volume= 0.125 ac, Depth= 3.37"
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100YR-REV Rainfall=8.84"

Area (sf)	CN	Description
19,360	55	Woods, Good, HSG B 100.00% Previous Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry, TRAVEL TIME

Subcatchment 7P: DA#7P

Hydrograph



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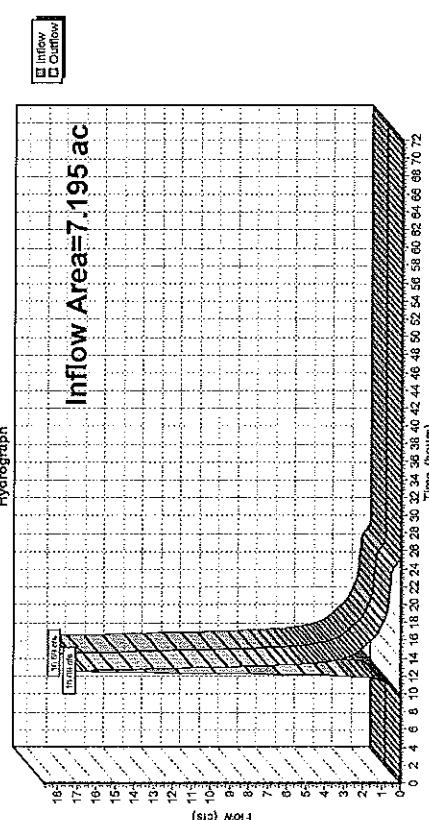
Type III 24-hr 100YR-REV Rainfall=8.84"
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Summary for Reach IP#1: VERNAL POOL

Inflow Area = 7.195 ac, 7.66% Impervious, Inflow Depth = 3.98" for 100YR-REV event
Inflow = 16.69 cfs @ 12.55 hrs, Volume= 2.384 af
Outflow = 16.69 cfs @ 12.55 hrs, Volume= 2.384 af, Atten= 0%, Lag= 0.0 min
Routing by Star-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Reach IP#1: VERNAL POOL

Hydrograph



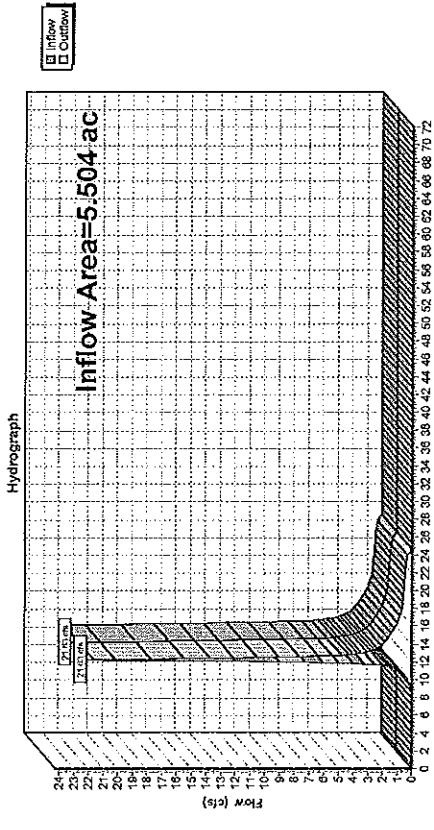
post development 1-17 Type III 24-hr 100YR-REV Rainfall=8.84"
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Summary for Reach IP#2: PROP LINE

Inflow Area = 5.504 ac, 9.68% Impervious, Inflow Depth = 4.34" for 100YR-REV event
Inflow = 21.63 cfs @ 12.20 hrs, Volume= 1.991 af
Outflow = 21.63 cfs @ 12.20 hrs, Volume= 1.991 af, Atten= 0%, Lag= 0.0 min

Routing by StoR-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Reach IP#2: PROP LINE



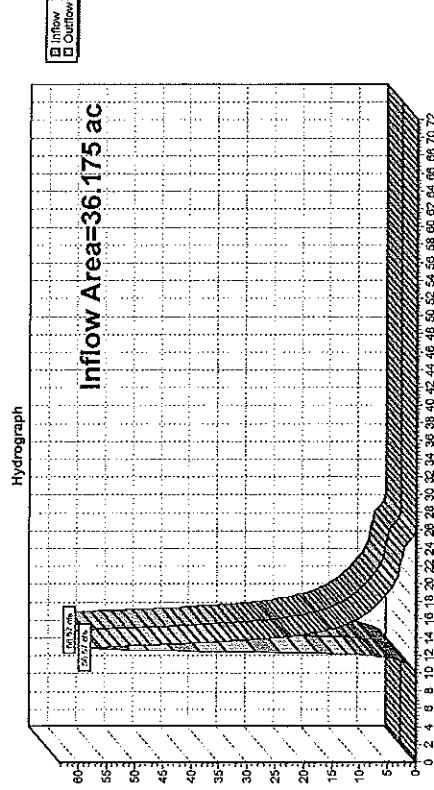
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Summary for Reach IP#3: WETLANDS

Inflow Area = 36.175 ac, 13.65% Impervious, Inflow Depth = 4.11" for 100YR-REV event
Inflow = 56.57 cfs @ 12.80 hrs, Volume= 12.379 af
Outflow = 56.57 cfs @ 12.80 hrs, Volume= 12.379 af, Atten= 0%, Lag= 0.0 min

Routing by StoR-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Reach IP#3: WETLANDS



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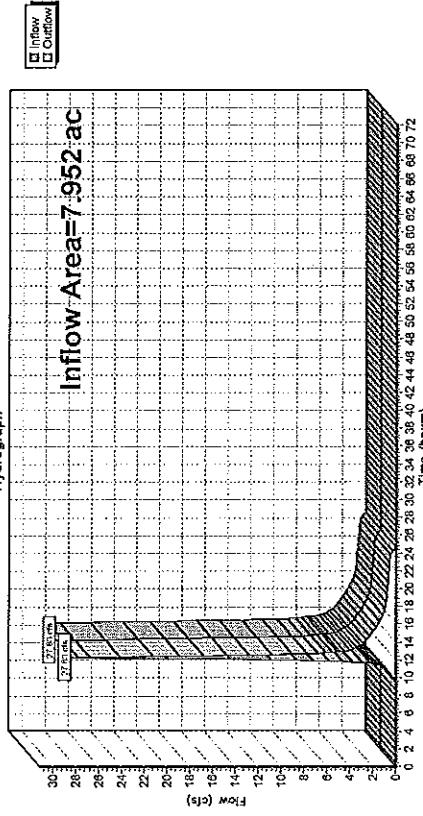
Summary for Reach IP#4: PROP. LINE

Inflow Area = 7.952 ac, 4.43% Impervious, Inflow Depth = 3.98" for 100YR-REV event
Inflow = 27.33 cfs @ 12.21 hrs, Volume= 2,635 af
Outflow = 27.33 cfs @ 12.21 hrs, Volume= 2,635 af, Atten= 0%, Lag= 0.0 min

Routing by Sto-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

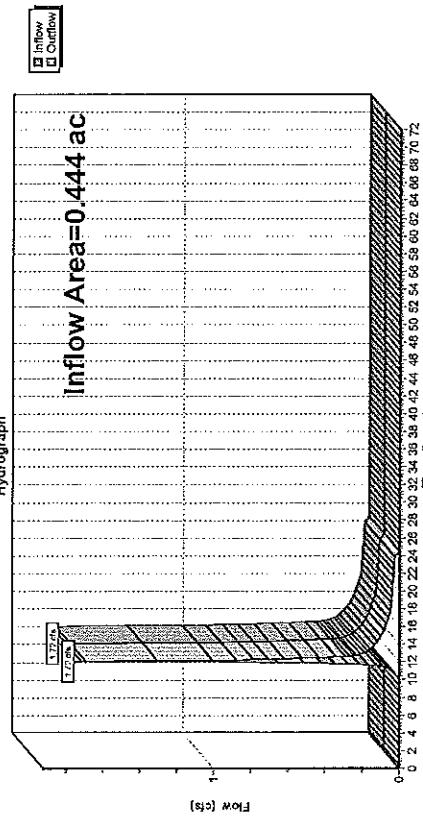
Reach IP#4: PROP. LINE

Hydrograph



Reach IP#5: PROP. LINE

Hydrograph



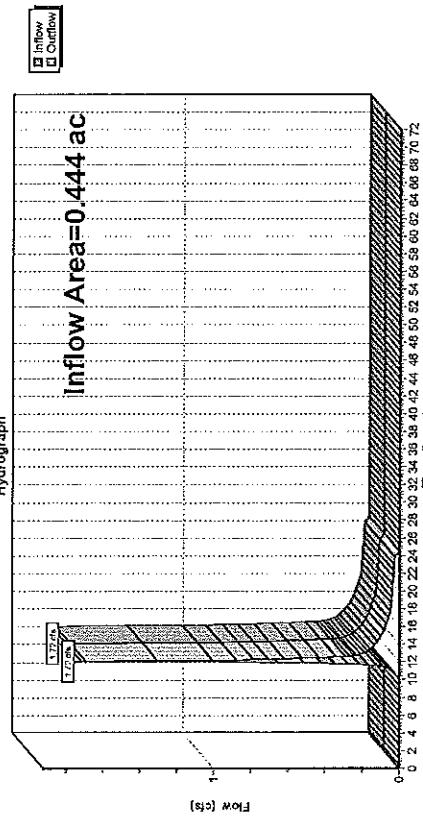
Summary for Reach IP#5: PROP. LINE

Inflow Area = 0.444 ac, 0.00% Impervious, Inflow Depth = 3.37" for 100YR-REV event
Inflow = 1.72 cfs @ 12.08 hrs, Volume= 0.125 af
Outflow = 1.72 cfs @ 12.08 hrs, Volume= 0.125 af, Atten= 0%, Lag= 0.0 min

Routing by Sto-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Reach IP#5: PROP. LINE

Hydrograph



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Summary for Pond PND1: BASIN#1

Inflow Area = 8.791 ac, 34.42% Impervious, Inflow Depth = 5.55" for 100YR-REV event
 Inflow = 35.54 cfs @ 12.33 hrs, Volume= 4,074 af
 Outflow = 11.05 cfs @ 12.38 hrs, Volume= 4,074 af, Attenu= 59%, Lag= 33.2 min
 Discarded = 0.38 cfs @ 12.88 hrs, Volume= 0.561 af
 Primary = 10.67 cfs @ 12.88 hrs, Volume= 3.512 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
 Peak Elev= 380.39' @ 12.88 hrs. Surf.Area= 15,927 sf, Storage= 72,625 cf
 Plug-Flow detention time= 151.9 min calculated for 4.071 af (100% of inflow)
 Center-of-Mass det. time= 152.5 min (983.6 - 831.1)

Volume	Invert	Avail.Storage	Storage Description	Custom Stage Data (Prismatic) Listed below (Recalc)
#1	374.00'	82,639 cf		

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
374.00	7,184	0	0
376.00	9,666	16,850	16,850
378.00	12,357	22,023	38,873
380.00	15,306	27,663	66,536
381.00	16,900	16,103	82,639

Device Routing Invert Outflow Devices

#1	Discarded	374.00'	1.020 in/hr Exfiltration over Surface area
#2	Primary	375.00'	6.0" Vert. Orifice/Grate C= 0.600
#3	Primary	375.25'	8.0" Vert. Orifice/Grate C= 0.600
#4	Primary	378.25'	12.0" Vert. Orifice/Grate C= 0.600

Discarded OutFlow Max=0.38 cfs @ 12.88 hrs HW=380.39' (Free Discharge)

1=Exfiltration (Exfiltration Controls 0.38 cfs)

Primary OutFlow Max=10.67 cfs @ 12.88 hrs HW=380.39' (Free Discharge)

2=Orifice/Grate (Orifice Controls 2.14 cfs @ 10.91 fps)

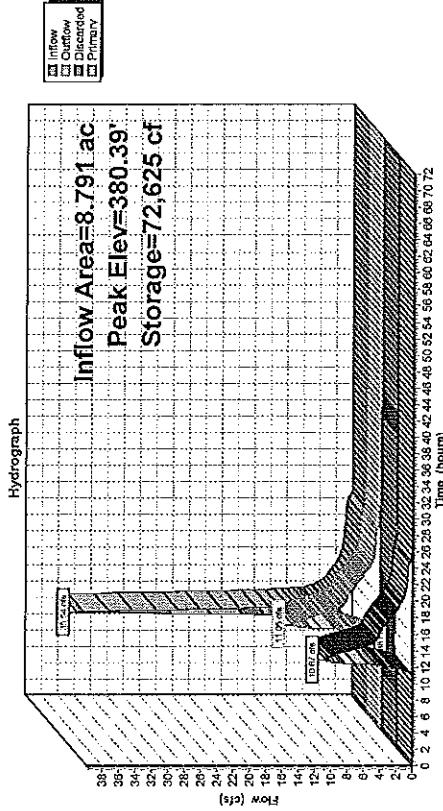
3=Orifice/Grate (Orifice Controls 3.68 cfs @ 10.55 fps)

4=Orifice/Grate (Orifice Controls 4.84 cfs @ 6.16 fps)

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Pond PND1: BASIN#1



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Summary for Pond PND2: BASIN#2

Inflow Area = 8.582 ac, 13.11% Impervious, Inflow Depth = 4.46" for 100YR-REV event
Inflow = 22.11 cfs @ 12.56 hrs, Volume= 3.191 af
Outflow = 13.01 cfs @ 12.57 hrs, Volume= 3.191 af, Attenu= 41%, Lag= 24.9 min
Discarded = 0.24 cfs @ 12.97 hrs, Volume= 0.175 af
Primary = 12.77 cfs @ 12.97 hrs, Volume= 3.016 af

Routing by Sto-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 374.67' @ 12.97 hrs Surf.Area= 9.974 sf Storage= 32,344 cf
Plug-Flow detention time= 40.8 min calculated for 3.189 af (100% of inflow)
Center-of-Mass det. time= 40.8 min (304.7 - 863.9)

Volume	Invert	Avail.Storage	Storage Description	Custom Stage Data (Prismatic) Listed below (Recalc)
#1	370.00'	35,650 cf		

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
370.00	3,750	0	0
372.00	6,400	10,150	10,150
374.00	9,300	15,700	25,850
375.00	10,300	9,800	35,650

Device Routing Invert Outlet Devices

#1	Discarded	370.00'	1.020 in/hr Exfiltration over Surface area
#2	Primary	370.00'	8.0" Vert. Orifice/Grate C= 0.600
#3	Primary	370.75'	10.0" Vert. Orifice/Grate C= 0.600
#4	Primary	372.85'	12.0" Vert. Orifice/Grate C= 0.600

Discarded OutFlow Max=0.24 cfs @ 12.97 hrs HW=374.67' (Free Discharge)

↓=1=Exfiltration (Exfiltration Controls 0.24 cfs)

Primary OutFlow Max=12.76 cfs @ 12.97 hrs HW=374.67' (Free Discharge)

↓=2=Orifice/Grate (Orifice Controls 3.50 cfs @ 10.03 fps)

↓=3=Orifice/Grate (Orifice Controls 4.32 cfs @ 9.01 fps)

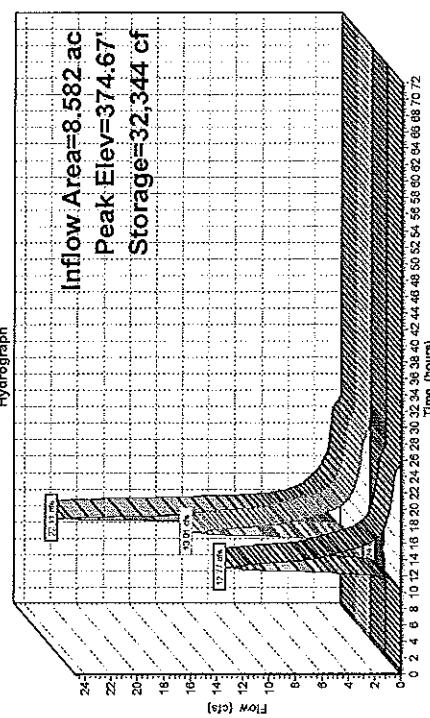
↓=4=Orifice/Grate (Orifice Controls 4.35 cfs @ 5.53 fps)

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Pond PND2: BASIN#2

Inflow
 Outflow
 Discarded



Flow (cfs)

Time (hours)

Pipe Calculations

Job No. W-2558

Gummere & Fallon Inc
1022 Providence Road
Whitinsville, MA 01588

DESIGN COMPUTATIONS FOR STORM DRAINS

Storm Intensity	2-Year	5-Year	10-Year	15-Year	20-Year	50-Year	100-Year
1.1	1.1	1.4	1.7	1.7	2.0	2.4	2.5
5-Year	1.1	1.4	1.7	1.7	2.0	2.4	2.5
10-Year							
15-Year							
20-Year							
50-Year							
100-Year							

Sheet No.: Drawn _____
Storm Prod.: 25-Year _____
Date: 9/6/2016 _____
Revised: 6/13/2017 _____
Composed By: P.Lawrie _____

Drainage Area	Stations or Manholes		Time of concentration		Runoff Coefficient	Tributary Area	CvDa	X(CvDa)	Rainfall Intensity (I)	Peak Flow	PROPOSED STORM DRAIN DATA						Invert Elevation					
	From	To	min	C							Pipe Dia.	Box Culvert W	D	Slope	Length	Capacity	Velocity	4/CD	Time	Upper End	Lower End	Remarks
ds32	ds32	dsb18	7	0.59	0.150	0.10					12			0.0100	18	103.352	103.211	103.573	48.30	144.612		
ds33	ds33	dsb18	10	0.58	0.150	0.10					12			0.0100	8	105.571	105.535	105.221	105.441	105.283	48.30	144.612
ds30	dsb13	dsb17	10	0.58	0.400	0.27					12			0.0068	259	105.555	105.525	105.564	105.622	105.357	48.30	144.612
ds31	dsb30	dsb17	7	0.68	0.80	0.10					12			0.0100	18	105.571	105.535	105.594	105.621	105.357	47.56	144.612
dsb17	dsb17	dsb17	10	0.68	0.610	0.42					12			0.0100	3	103.352	103.211	103.573	104.166	104.155	47.56	144.612
dsb17	dsb19	dsb17	10	0.68	1.090	0.79					12			0.0225	164	108.020	107.688	107.722	108.349	108.380	42.10	143.542
dsb17	dsb17	dsb17	10	0.68	1.090	0.79					12			0.0225	164	108.020	107.688	107.722	108.349	108.380	42.10	143.542
dsb17	dsb17	dsb17	10	0.68	1.090	0.79					12			0.0225	164	108.020	107.688	107.722	108.349	108.380	42.10	143.542
dsb17	dsb17	dsb17	10	0.68	1.090	0.79					12			0.0225	164	108.020	107.688	107.722	108.349	108.380	42.10	143.542
dsb17	dsb17	dsb17	10	0.68	1.090	0.79					12			0.0225	164	108.020	107.688	107.722	108.349	108.380	42.10	143.542
dsb17	dsb17	dsb17	10	0.68	1.090	0.79					12			0.0225	164	108.020	107.688	107.722	108.349	108.380	42.10	143.542
dsb17	dsb17	dsb17	10	0.68	1.090	0.79					12			0.0225	164	108.020	107.688	107.722	108.349	108.380	42.10	143.542
dsb17	dsb17	dsb17	10	0.68	1.090	0.79					12			0.0225	164	108.020	107.688	107.722	108.349	108.380	42.10	143.542
dsb17	dsb17	dsb17	10	0.68	1.090	0.79					12			0.0225	164	108.020	107.688	107.722	108.349	108.380	42.10	143.542
dsb17	dsb17	dsb17	10	0.68	1.090	0.79					12			0.0225	164	108.020	107.688	107.722	108.349	108.380	42.10	143.542
dsb17	dsb17	dsb17	10	0.68	1.090	0.79					12			0.0225	164	108.020	107.688	107.722	108.349	108.380	42.10	143.542
dsb17	dsb17	dsb17	10	0.68	1.090	0.79					12			0.0225	164	108.020	107.688	107.722	108.349	108.380	42.10	143.542
dsb17	dsb17	dsb17	10	0.68	1.090	0.79					12			0.0225	164	108.020	107.688	107.722	108.349	108.380	42.10	143.542
dsb17	dsb17	dsb17	10	0.68	1.090	0.79					12			0.0225	164	108.020	107.688	107.722	108.349	108.380	42.10	143.542
dsb17	dsb17	dsb17	10	0.68	1.090	0.79					12			0.0225	164	108.020	107.688	107.722	108.349	108.380	42.10	143.542
dsb17	dsb17	dsb17	10	0.68	1.090	0.79					12			0.0225	164	108.020	107.688	107.722	108.349	108.380	42.10	143.542
dsb17	dsb17	dsb17	10	0.68	1.090	0.79					12			0.0225	164	108.020	107.688	107.722	108.349	108.380	42.10	143.542
dsb17	dsb17	dsb17	10	0.68	1.090	0.79					12			0.0225	164	108.020	107.688	107.722	108.349	108.380	42.10	143.542
dsb17	dsb17	dsb17	10	0.68	1.090	0.79					12			0.0225	164	108.020	107.688	107.722	108.349	108.380	42.10	143.542
dsb17	dsb17	dsb17	10	0.68	1.090	0.79					12			0.0225	164	108.020	107.688	107.722	108.349	108.380	42.10	143.542
dsb17	dsb17	dsb17	10	0.68	1.090	0.79					12			0.0225	164	108.020	107.688	107.722	108.349	108.380	42.10	143.542
dsb17	dsb17	dsb17	10	0.68	1.090	0.79					12			0.0225	164	108.020	107.688	107.722	108.349	108.380	42.10	143.542
dsb17	dsb17	dsb17	10	0.68	1.090	0.79					12			0.0225	164	108.020	107.688	107.722	108.349	108.380	42.10	143.542
dsb17	dsb17	dsb17	10	0.68	1.090	0.79					12			0.0225	164	108.020	107.688	107.722	108.349	108.380	42.10	143.542
dsb17	dsb17	dsb17	10	0.68	1.090	0.79					12			0.0225	164	108.020	107.688	107.722	108.349	108.380	42.10	143.542
dsb17	dsb17	dsb17	10	0.68	1.090	0.79					12			0.0225	164	108.020	107.688	107.722	108.349	108.380	42.10	143.542
dsb17	dsb17	dsb17	10	0.68	1.090	0.79					12			0.0225	164	108.020	107.688	107.722	108.349	108.380	42.10	143.542
dsb17	dsb17	dsb17	10	0.68	1.090	0.79					12			0.0225	164	108.020	107.688	107.722	108.349	108.380	42.10	143.542
dsb17	dsb17	dsb17	10	0.68	1.090	0.79					12			0.0225	164	108.020	107.688	107.722	108.349	108.380	42.10	143.542
dsb17	dsb17	dsb17	10	0.68	1.090	0.79					12			0.0225	164	108.020	107.688	107.722	108.349	108.380	42.10	143.542
dsb17	dsb17	dsb17	10	0.68	1.090	0.79					12			0.0225	164	108.020	107.688	107.722	108.349	108.380	42.10	143.542
dsb17	dsb17	dsb17	10	0.68	1.090	0.79					12			0.0225	164	108.020	107.688	107.722	108.349	108.380	42.10	143.542
dsb17	dsb17	dsb17	10	0.68	1.090	0.79					12			0.0225	164	108.020	107.688	107.722	108.349	108.380	42.10	143.542
dsb17	dsb17	dsb17	10	0.68	1.090	0.79					12			0.0225	164	108.020	107.688	107.722	108.349	108.380	42.10	143.542
dsb17	dsb17	dsb17	10	0.68	1.090	0.79					12			0.0225	164	108.020	107.688	107.722	108.349	108.380	42.10	143.542
dsb17	dsb17	dsb17	10	0.68	1.090	0.79					12			0.0225	164	108.020	107.688	107.722	108.349	108.380	42.10	143.542
dsb17	dsb17	dsb17	10	0.68	1.090	0.79					12			0.0225	164	108.020	107.688	107.722	108.349	108.380	42.10	143.542
dsb17	dsb17	dsb17	10	0.68	1.090	0.79					12			0.0225	164	108.020	107.688	107.722	108.349	108.380	42.10	143.542
dsb17	dsb17	dsb17	10	0.68	1.090	0.79					12			0.0225	164	108.020	107.688	107.722	108.349	108.380	42.10	143.542
dsb17	dsb17	dsb17	10	0.68	1.090	0.79					12			0.0225	164	108.020	107.688	107.722	108.349	108.380	42.10	143.542
dsb17	dsb17	dsb17	10	0.68	1.090	0.79					12			0.0225	164	108.020	107.688	107.722	108.349	108.380	42.10	143.542
dsb17	dsb17	dsb17	10	0.68	1.090	0.79					12			0.0225	164	108.020	107.688	107.722	108.349	108.380	42.10	143.542
dsb17	dsb17	dsb17	10	0.68	1.090	0.79					12			0.0225	164	108.020	107.688	107.722	108.349	108.380	42.10	143.542
dsb17	dsb17	dsb17	10	0.68	1.090	0.79																

Job No. W-2653

Job No. W-2658

DESIGN COMPUTATIONS FOR STORM DRAINS

S2000
 2-Year 1.1
 5-Year 1.4
 10-Year 1.7
 25-Year 2.0
 50-Year 2.4

Sheet No.: 25-14
 Storm Free: 25-Year
 Date: 2/16/2015
 Revised: 5/10/2017
 Computed By: P. Lavoie

Job No. w2653

DESIGN COMPUTATIONS FOR STORM DRAINS

Storm Date: 25-Year
Storm Date: 9/15/2016
Revised: 5/10/2017
Comments: 9/15/2017

Drainage Area	PROPOSED STORM DRAIN DATA							
	Sections or Manholes		Time of concentration		Runoff Coefficient		Tributary Area	
From	To	min	C	area	CSz	K(CSz)	Rainfall Intensity (in)	Peak Flow
ch14	dmb8	15	0.47	0.840	0.39	0.0639	0.459	12
ch15	dmb8	5	0.90	0.100	0.69	0.0501	0.670	12
dmb8	dmb9	13	0.67	0.940	0.63	0.0605	0.656	15
ch16	dmb9	15	0.46	0.680	0.31	0.0311	0.433	12
ch17	dmb9	5	0.90	0.104	0.69	0.0502	0.621	12
dmb9	10	0.68	1.000	0.74	0.0261	0.522	12	0.0725
ch18	dmb9	5	0.90	0.110	0.10	0.0101	0.656	12
dmb9	dmb10	13	0.46	0.920	1.34	0.0501	0.656	15
ch19	dmb10	5	0.90	0.140	0.13	0.0131	0.621	12
dmb9	dmb10	5	0.90	0.140	0.13	0.0131	0.656	12
dmb10	dmb11	15	0.47	3.210	0.59	0.0501	0.656	15
dmb11	dmb12	15	0.47	3.210	1.00	0.0501	0.656	15
ch20	dmb12	5	0.90	0.120	0.11	0.0131	0.621	12
ch21	dmb12	5	0.90	0.120	0.11	0.0131	0.656	12
dmb12	dmb13	15	0.47	3.450	1.11	0.0501	0.656	15
ch22	dmb13	5	0.90	0.130	0.12	0.0131	0.656	12
ch23	dmb13	5	0.90	0.130	0.12	0.0131	0.656	12
dmb13	dmb14	15	0.65	3.650	1.66	0.0501	0.656	18
ch24	dmb14	5	0.90	0.150	0.12	0.0131	0.656	12
ch25	dmb14	5	0.90	0.150	0.12	0.0131	0.656	12
dmb14	dmb15	17	0.65	2.890	1.88	0.0501	0.656	18
ch26	dmb15	17	0.56	5.200	2.91	0.0250	0.656	24
dmb15	17	0.56	5.200	2.91	0.0250	0.656	24	0.0220
ch26	dmb15	5	0.90	0.150	0.12	0.0131	0.656	12
ch27	dmb15	8	0.52	0.550	0.29	0.0120	0.656	12
dmb15	dmb16	17	0.55	6.970	3.23	0.0333	0.656	24
ch28	dmb16	8	0.55	1.040	0.57	0.0150	0.656	12
dmb16	dmb17	17	0.55	8.060	3.79	0.0175	0.656	24
dmb17	st1	17	0.55	8.090	3.79	0.0175	0.656	24
st1	hw1	17	0.55	8.090	3.79	0.0175	0.656	24
hw1	hw2	17	0.55	8.090	3.79	0.0175	0.656	24
hw2	hw3	17	0.55	8.090	3.79	0.0175	0.656	24
hw3	hw4	17	0.55	8.090	3.79	0.0175	0.656	24
hw4	hw5	17	0.55	8.090	3.79	0.0175	0.656	24
hw5	hw6	17	0.55	8.090	3.79	0.0175	0.656	24
hw6	hw7	17	0.55	8.090	3.79	0.0175	0.656	24
hw7	hw8	17	0.55	8.090	3.79	0.0175	0.656	24
hw8	hw9	17	0.55	8.090	3.79	0.0175	0.656	24
hw9	hw10	17	0.55	8.090	3.79	0.0175	0.656	24
hw10	hw11	17	0.55	8.090	3.79	0.0175	0.656	24
hw11	hw12	17	0.55	8.090	3.79	0.0175	0.656	24
hw12	hw13	17	0.55	8.090	3.79	0.0175	0.656	24
hw13	hw14	17	0.55	8.090	3.79	0.0175	0.656	24
hw14	hw15	17	0.55	8.090	3.79	0.0175	0.656	24
hw15	hw16	17	0.55	8.090	3.79	0.0175	0.656	24
hw16	hw17	17	0.55	8.090	3.79	0.0175	0.656	24
hw17	hw18	17	0.55	8.090	3.79	0.0175	0.656	24
hw18	hw19	17	0.55	8.090	3.79	0.0175	0.656	24
hw19	hw20	17	0.55	8.090	3.79	0.0175	0.656	24
hw20	hw21	17	0.55	8.090	3.79	0.0175	0.656	24
hw21	hw22	17	0.55	8.090	3.79	0.0175	0.656	24
hw22	hw23	17	0.55	8.090	3.79	0.0175	0.656	24
hw23	hw24	17	0.55	8.090	3.79	0.0175	0.656	24
hw24	hw25	17	0.55	8.090	3.79	0.0175	0.656	24
hw25	hw26	17	0.55	8.090	3.79	0.0175	0.656	24
hw26	hw27	17	0.55	8.090	3.79	0.0175	0.656	24
hw27	hw28	17	0.55	8.090	3.79	0.0175	0.656	24
hw28	hw29	17	0.55	8.090	3.79	0.0175	0.656	24
hw29	hw30	17	0.55	8.090	3.79	0.0175	0.656	24
hw30	hw31	17	0.55	8.090	3.79	0.0175	0.656	24
hw31	hw32	17	0.55	8.090	3.79	0.0175	0.656	24
hw32	hw33	17	0.55	8.090	3.79	0.0175	0.656	24
hw33	hw34	17	0.55	8.090	3.79	0.0175	0.656	24
hw34	hw35	17	0.55	8.090	3.79	0.0175	0.656	24
hw35	hw36	17	0.55	8.090	3.79	0.0175	0.656	24
hw36	hw37	17	0.55	8.090	3.79	0.0175	0.656	24
hw37	hw38	17	0.55	8.090	3.79	0.0175	0.656	24
hw38	hw39	17	0.55	8.090	3.79	0.0175	0.656	24
hw39	hw40	17	0.55	8.090	3.79	0.0175	0.656	24
hw40	hw41	17	0.55	8.090	3.79	0.0175	0.656	24
hw41	hw42	17	0.55	8.090	3.79	0.0175	0.656	24
hw42	hw43	17	0.55	8.090	3.79	0.0175	0.656	24
hw43	hw44	17	0.55	8.090	3.79	0.0175	0.656	24
hw44	hw45	17	0.55	8.090	3.79	0.0175	0.656	24
hw45	hw46	17	0.55	8.090	3.79	0.0175	0.656	24
hw46	hw47	17	0.55	8.090	3.79	0.0175	0.656	24
hw47	hw48	17	0.55	8.090	3.79	0.0175	0.656	24
hw48	hw49	17	0.55	8.090	3.79	0.0175	0.656	24
hw49	hw50	17	0.55	8.090	3.79	0.0175	0.656	24
hw50	hw51	17	0.55	8.090	3.79	0.0175	0.656	24
hw51	hw52	17	0.55	8.090	3.79	0.0175	0.656	24
hw52	hw53	17	0.55	8.090	3.79	0.0175	0.656	24
hw53	hw54	17	0.55	8.090	3.79	0.0175	0.656	24
hw54	hw55	17	0.55	8.090	3.79	0.0175	0.656	24
hw55	hw56	17	0.55	8.090	3.79	0.0175	0.656	24
hw56	hw57	17	0.55	8.090	3.79	0.0175	0.656	24
hw57	hw58	17	0.55	8.090	3.79	0.0175	0.656	24
hw58	hw59	17	0.55	8.090	3.79	0.0175	0.656	24
hw59	hw60	17	0.55	8.090	3.79	0.0175	0.656	24
hw60	hw61	17	0.55	8.090	3.79	0.0175	0.656	24
hw61	hw62	17	0.55	8.090	3.79	0.0175	0.656	24
hw62	hw63	17	0.55	8.090	3.79	0.0175	0.656	24
hw63	hw64	17	0.55	8.090	3.79	0.0175	0.656	24
hw64	hw65	17	0.55	8.090	3.79	0.0175	0.656	24
hw65	hw66	17	0.55	8.090	3.79	0.0175	0.656	24
hw66	hw67	17	0.55	8.090	3.79	0.0175	0.656	24
hw67	hw68	17	0.55	8.090	3.79	0.0175	0.656	24
hw68	hw69	17	0.55	8.090	3.79	0.0175	0.656	24
hw69	hw70	17	0.55	8.090	3.79	0.0175	0.656	24
hw70	hw71	17	0.55	8.090	3.79	0.0175	0.656	24
hw71	hw72	17	0.55	8.090	3.79	0.0175	0.656	24
hw72	hw73	17	0.55	8.090	3.79	0.0175	0.656	24
hw73	hw74	17	0.55	8.090	3.79	0.0175	0.656	24
hw74	hw75	17	0.55	8.090	3.79	0.0175	0.656	24
hw75	hw76	17	0.55	8.090	3.79	0.0175	0.656	24
hw76	hw77	17	0.55	8.090	3.79	0.0175	0.656	24
hw77	hw78	17	0.55	8.090	3.79	0.0175	0.656	24
hw78	hw79	17	0.55	8.090	3.79	0.0175	0.656	24
hw79	hw80	17	0.55	8.090	3.79	0.0175	0.656	24
hw80	hw81	17	0.55	8.090	3.79	0.0175	0.656	24
hw81	hw82	17	0.55	8.090	3.79	0.0175	0.656	24
hw82	hw83	17	0.55	8.090	3.79	0.0175	0.656	24
hw83	hw84	17	0.55	8.090	3.79	0.0175	0.656	24
hw84	hw85	17	0.55	8.090	3.79	0.0175	0.656	24
hw85	hw86	17	0.55	8.090	3.79	0.0175	0.656	24
hw86	hw87	17	0.55	8.090	3.79	0.0175	0.656	24
hw87	hw88	17	0.55	8.090	3.79	0.0175	0.656	24
hw88	hw89	17	0.55	8.090	3.79	0.0175	0.656	24
hw89	hw90	17	0.55	8.090	3.79	0.0175	0.656	24
hw90	hw91	17	0.55	8.090	3.79	0.0175	0.656	24
hw91	hw92	17	0.55	8.090	3.79	0.0175	0.656	24
hw92	hw93	17	0.55	8.090	3.79	0.0175	0.656	24
hw93	hw94	17	0.55	8.090	3.79	0.0175	0.656	24
hw94	hw95	17	0.55	8.090	3.79	0.0175	0.656	24
hw95	hw96	17	0.55	8.090	3.79	0.0175	0.656	24
hw96	hw97	17	0.55	8.090	3.79	0.0175	0.656	24
hw97	hw98	17	0.55	8.090	3.79	0.0175	0.656	24
hw98	hw99	17	0.55	8.090	3.79	0.0175	0.656	24
hw99	hw100	17	0.55	8.090	3.79	0.0175	0.656	24
hw100	hw101	17	0.55	8.090	3.79	0.0175	0.656	24
hw101	hw102	17	0.55	8.090	3.79	0.0175	0.656	24
hw102	hw103	17	0.55	8.090	3.79	0.0175	0.656	24
hw103	hw104	17	0.55	8.090	3.79	0.0175	0.656	24
hw104	hw105	17	0.55	8.090	3.79	0.0175	0.656	24
hw105	hw106	17	0.55	8.090	3.79	0.0175	0.656	24
hw106	hw107	17	0.55	8.090	3.79	0.0175	0.656	24
hw107	hw108	17	0.55	8.090	3.79	0.0175	0.656	24
hw108	hw109	17	0.55	8.090	3.79	0.0175	0.656	24
hw109	hw110	17	0.55	8.090	3.79	0.0175	0.656	24
hw110	hw111	17	0.55	8.090	3.79	0.0175	0.656	24
hw111	hw112	17	0.55	8.090	3.79	0.0175	0.656	24
hw112	hw113	17	0.55	8.09				

DRAINAGE ANALYSIS

HydroCAD Calculations – Existing Conditions

PRE DEVELOPMENT

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 Page 2

Area Listing (all nodes)

Area (acres)	CN	Description (subattachment-numbers)
6.981	61	>75% Grass cover, Good, HSG B (3E, 4E)
0.932	82	Dirt roads, HSG B (1E, 2E)
0.786	98	Paved parking & roofs (3E)
0.275	98	Water Surface, HSG B (4E)
52.916	58	Woods/grass comb., Good, HSG B (1E, 2E, 3E, 4E)

